SOUTHERN CALIFORNIA

ASSOCIATION of GOVERNMENTS

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MEETING OF THE

OPEN SPACE WORKING GROUP

Tuesday, September 12, 2006
10:00 a.m. – 12:00 noon
SCAG Offices
818 West 7th Street, 12th Floor
Conference Room Riverside A
Los Angeles, CA 90017
213.236.1800

Video Conferencing Available:

SCAG Offices – Riverside
3600 Lime Street, Suite 216
Riverside, CA 92501
951.784.1513

Please RSVP 24 hours in advance.

If members of the public wish to review the attachments or have any questions on any of the agenda items, please contact Jill Egerman at 213.236.1919 or egerman@scag.ca.gov

SCAG, in accordance with the Americans with Disabilities Act (ADA), will accommodate persons who require a modification of accommodation in order to participate in this meeting. If you require such assistance, please contact SCAG at (213) 236-1868 at least 72 hours in advance of the meeting to enable SCAG to make reasonable arrangements. To request documents related to this document in an alternative format, please contact (213) 236-1868.

OPEN SPACE WORK GROUP

AGENDA

			PAGE #	TIME
1.0	CALL TO ORDER and PLEDGE of ALLEGIANCE	**Mark A. Pisano Executive Director**		
2.0	ELECTION OF CHAIR and VICE-CHAIR			
3.0	PUBLIC COMMENT PERIOD			

Members of the public desiring to speak on an agenda item or items not on the agenda, but within the purview of the Committee, must fill out and present a speaker's card to the Assistant prior to speaking. A speaker's card must be turned in before the meeting is called to order. Comments will be limited to three minutes. The chair may limit the total time for all comments to twenty (20) minutes.

4.0	REVIEW and PRIORITIZE AGENDA ITEMS			
5.0	CONSENT CALENDAR			
5.1	Approval Items			
5.1.1	Minutes of July 11, 2006		01	
6.0	INFORMATION ITEMS			
6.1	**Presentations on Existing Programs in SCAG Region**			
6.1.1	Presentation by Elizabeth Chattin **Handout** Presentation on wildlife crossing mitigation, and demonstrations of how crossing structures can be retrofitted to facilitate wildlife movement	**Elizabeth Chattin Ventura County**		15 minutes
6.1.2	Presentation by Kristeen Penrod **Attachment** Presentation on landscape linkages through the South Coast Ecoregion.	**Kristeen Penrod, Executive Director South Coast Wildlands**	03	15 minutes

OPEN SPACE WORK GROUP

AGENDA

			PAGE #	TIME
6.2	Presentation by SCAG Consultant team **Attachment** Consultant team will present on SCAG's corridor and linkage efforts for the Open Space Program. Consultant will introduce outreach program, solicit OSWG members' recommendations for focus of presentation and target audience.	**Paul Beier, Ph.D** **Jean Carr** **Jones & Stokes**	**52**	30 minutes
6.3	Mitigation Measures **Attachment** Staff will discuss mitigation measures from the 2004 RTP, and the plan for outreach and getting input for improving current and future mitigation measures.	**Jessica Kirchner** **SCAG Staff**	**61**	10 Minutes
6.4	Chapter Organization **Attachment** Staff will present on how the Open Space and Habitat Chapter of the RCP will be organized.	**Jill Egerman** **SCAG Staff**	**86**	10 Minutes
6.5	Chapter Update **Attachment** Staff will present the initial proposal for the Goals and Strategies, and the current Policies for the Chapter for discussion.	**Jessica Kirchner** **SCAG Staff**	**89**	15 Minutes
6.6	Implementation Concepts Subgroup Report A member of the Subgroup will report to the Working Group on the first meeting.	**Subgroup Member**		**5 Minutes**

OPEN SPACE WORK GROUP

AGENDA

PAGE # TIME

7.0 CHAIR'S REPORT

8.0 STAFF REPORT

8.1 Staff will report on upcoming schedule and future topics

9.0 FUTURE AGENDA ITEMS

Any Committee members or staff desiring to place items on a future agenda may make such request. Comments should be limited to three (3) minutes.

10.0 ANNOUNCEMENTS

11.0 ADJOURNMENT

OPEN SPACE WORKING GROUP
of the
SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

July 11, 2006
Minutes

THE FOLLOWING MINUTES ARE A SUMMARY OF ACTIONS TAKEN BY THE OPEN SPACE WORKING GROUP. AN AUDIOCASSETTE TAPE OF THE ACTUAL MEETING IS AVAILABLE FOR LISTENING IN SCAG'S OFFICES

The Open Space Working Group held its meeting at the offices of SCAG, Riverside B Conference Room on July 11, 2006. The meeting was scheduled for 10:00 am to Noon. SCAG project managers for this meeting were Jacob Lieb, Jessica Kirchner and Jill Egerman. The meeting was called to order by Jacob Lieb.

Members Present	Representing
April Sall	The Wildlands Conservancy
Dick Crowe	California Bureau of Land Management
Greg Thomson	California Bureau of Land Management
Bob Reid	Trust for Public Land
Glen Dake	Glen Dake Landscape Architect
Jeffrey Harlan	Baldwin Hills Conservancy
Margaret Clarke	City of Rosemead and the San Gabriel Mountains Regional Conservancy
Yvonne Savio	University of California Cooperative Extension
Prof. Jennifer Wolch	USC Center for Sustainable Cities
Mark Grey	BIA
Lindell Marsh, Esq.	Attorney
Kally McCormick	Caltrans
Jeannie Gillen	California Recreational Trails Committee
Dan Silver	Endangered Habitats League
Alfredo Gonzalez	The Nature Conservancy
Greg Pettis (teleconference)	City of Cathedral City
Hon. Pam O'Connor	City of Santa Monica

1.0 CALL TO ORDER & PLEDGE OF ALLIGANCE

Jacob Lieb called the meeting to order.

2.0 ELECTION OF CHAIR & VICE CHAIR

The election of chair and vice chair will be determined at the next meeting.

3.0 PUBLIC COMMENT PERIOD

4.0 REVIEW and PRIORITIZE AGENDA ITEMS

OPEN SPACE WORKING GROUP
of the
SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

July 11, 2006
Minutes

5.0 CONSENT CALENDAR

5.1.1 Open Working Group Invitees
Attachments

6.0 INFORMATION ITEMS

6.1 Open Space Habitat Issues

6.2 Regional Comprehensive Plan Background
Jacob Lieb explained the organization and function of SCAG, the purpose of the Regional Comprehensive Plan and how the program relates to Open Spaces.

6.3 Open Space and Habitat Chapter
Jean Carr from the consulting firm of Jones and Stokes presented a PowerPoint slide presentation with an overview of the Open Space and Habitat Chapter.

6.4 Working Group Organization
To be determined at the next meeting.

6.5 Open Space Working Group Future Meeting Schedule
The Group agreed to meet bi-monthly, on the second Tuesday. The next meeting is scheduled for Tuesday, September, 12th at the SCAG offices in Los Angeles. The SCAG offices are under consideration for future meetings.

7.0 CHAIR'S REPORT

8.0 FUTURE AGENDA ITEMS

- Election of Chair and Vice Chair (September 2006)

9.0 ANNOUNCEMENTS

10.0 ADJOURNMENT

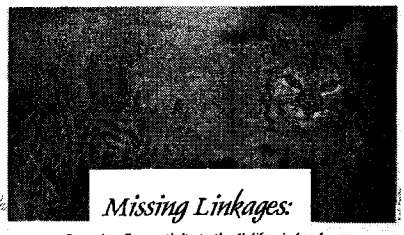
Electronic Signature

Jill Egerman, Staff to the Open
Space Working Group

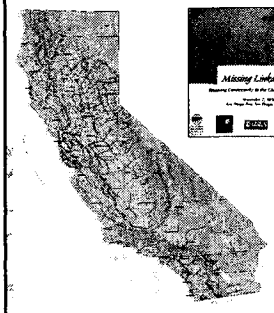
South Coast Missing Linkages Project – restoring connectivity to southern California

Kristeen Penrod, Clint Cabañero, Paul Beier, Wayne Spencer, Claudia Luke, Esther Rubin
(and numerous others)

2 November 2000

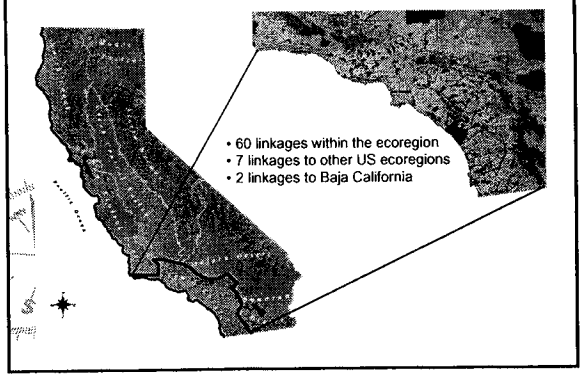


Missing Linkages Conference San Diego Zoo, November 2000

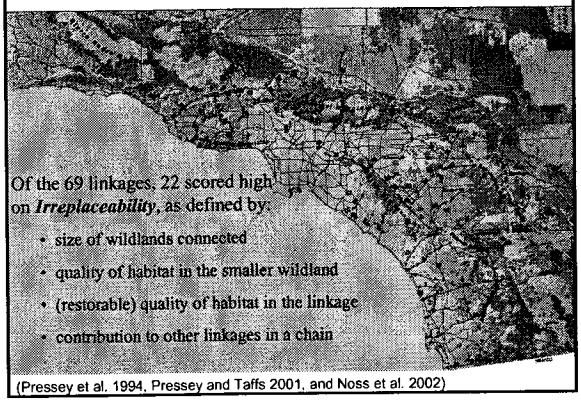


Identified Connections Among Protected Areas:
232 linkages
8 ecoregions

Missing Linkages Conference: South Coast Ecoregion

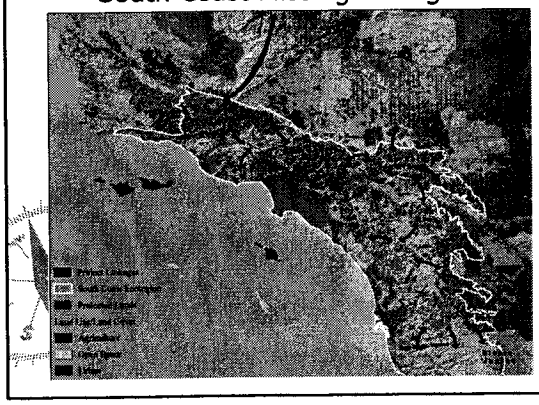


18 Jan 2002 – Linkage Prioritization workshop



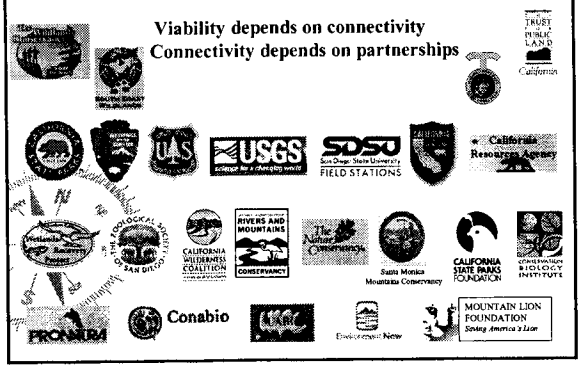
(Pressey et al. 1994, Pressey and Taffs 2001, and Noss et al. 2002)

South Coast Missing Linkages



South Coast Missing Linkages

Viability depends on connectivity
Connectivity depends on partnerships



Biological Foundation Workshops – 5 workshops, 15 linkages

Talks in the morning

Tom Oberbauer: plants | Kathy Williams: invertebrates | Phil Unitt: birds | Esther Rubin: bighorn | Ken Logan: puma

Taxonomic workgroups select focal species in the afternoon

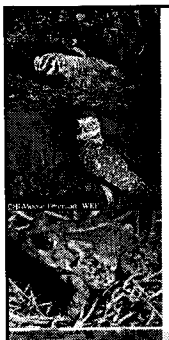
Select Focal Species

- Umbrella species (area-sensitive, sensitive to barriers)
- Range of vagilities & habitat affinities
- Species that need corridors AND *species that the corridor needs.*

Focal Species Approach
(Beier & Loe 1992)

Steve Loe
San Bernardino NF

Paul Beier
SCWP & NAU



109 Focal Species Selected

Mammals 17

Birds 20

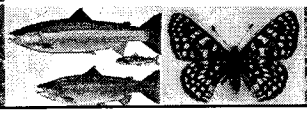
Amphibians 5

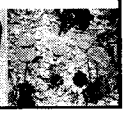
Reptiles 12

Fish 4

Invertebrates 25

Plants 26





Conservation Design:

GIS Analyses & Field Work

Landscape Permeability Analyses

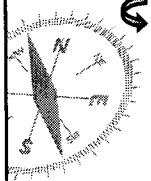
Habitat Suitability Analyses

Patch Size Analyses

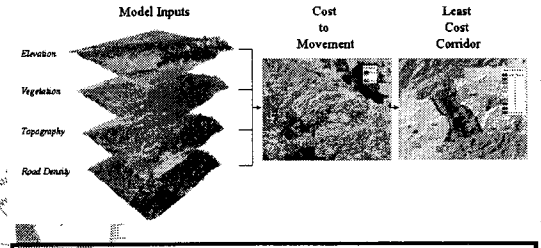
Configuration Analyses

Field Investigations

= Linkage Design



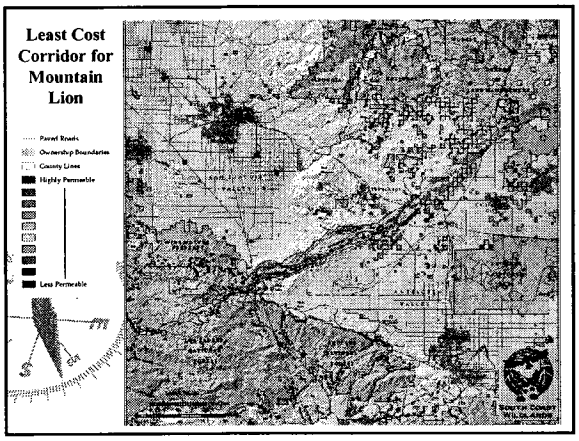
Landscape Permeability Analysis



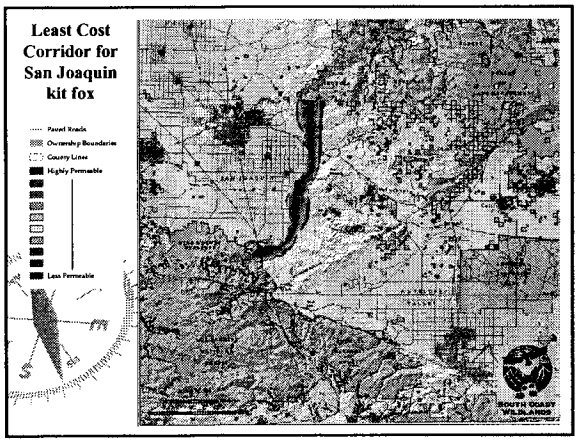
Goal: Define area with lowest relative cost of travel for focal species between protected core areas

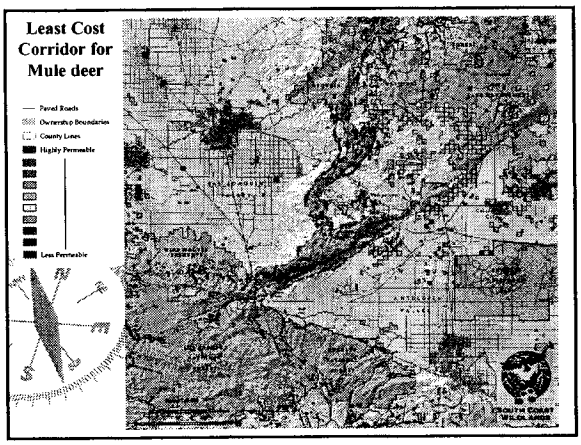
Walker and Craighead 1997
Craighead et al. 2001
Singleton et al. 2002

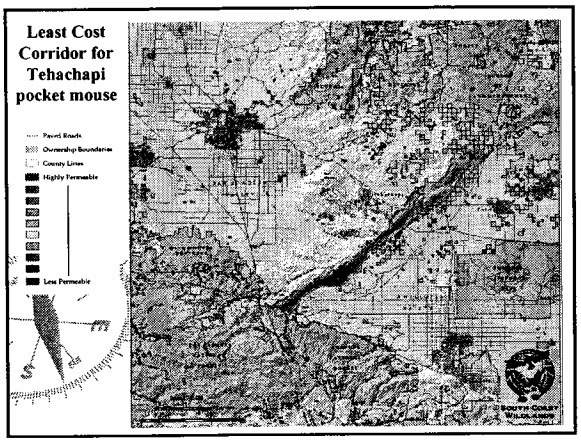
Least Cost Corridor for Mountain Lion

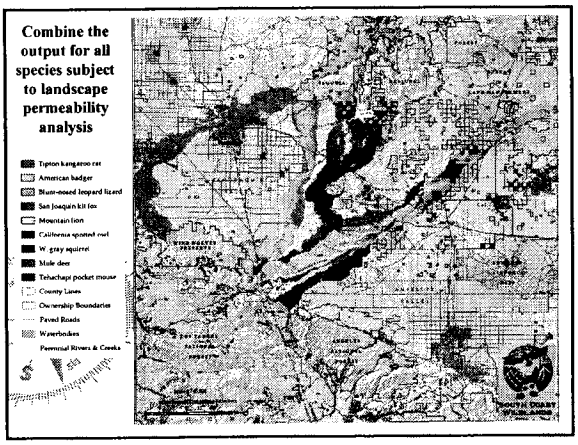


Least Cost Corridor for San Joaquin kit fox



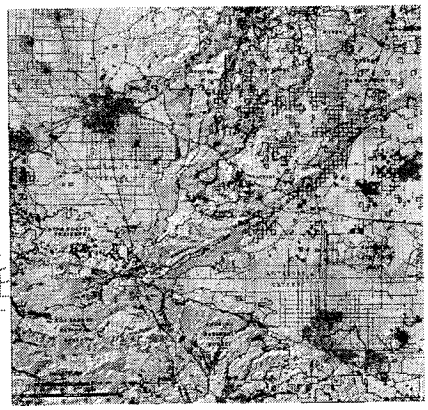

Least Cost Corridor for Mule deer
Paved Roads
Ownership Boundaries
County Lines
Highly Permeable
Less Permeable


Least Cost Corridor for Tehachapi pocket mouse
Paved Roads
Ownership Boundaries
County Lines
Highly Permeable
Less Permeable

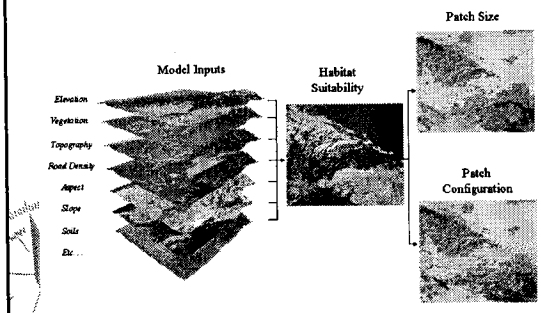

Combine the output for all species subject to landscape permeability analysis
Tipton kangaroo rat
American badger
Blunt-nosed leopard lizard
San Joaquin kit fox
Mountain lion
California spotted owl
W. gray squirrel
Mule deer
Tehachapi pocket mouse
County Lines
Ownership Boundaries
Paved Roads
Waterbodies
Perennial Rivers & Creeks

Least Cost Union

Evaluate habitat suitability, patch size, and patch configuration for all focal species in relation to the Union.

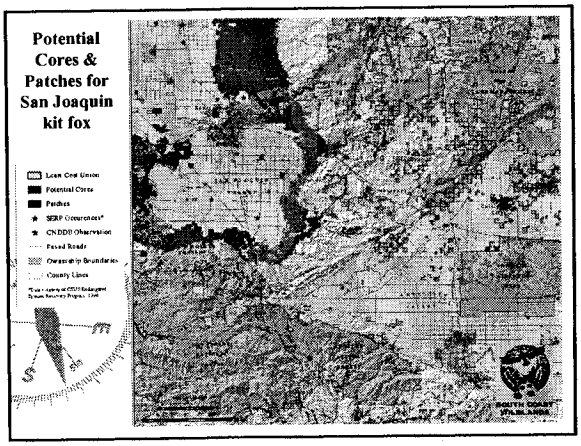


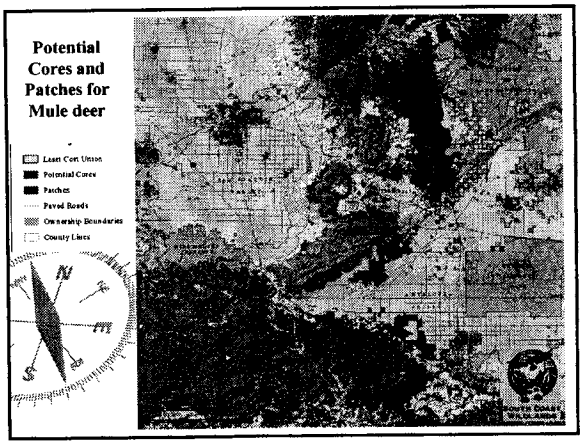
Habitat Suitability, Patch Size, and Configuration Analyses

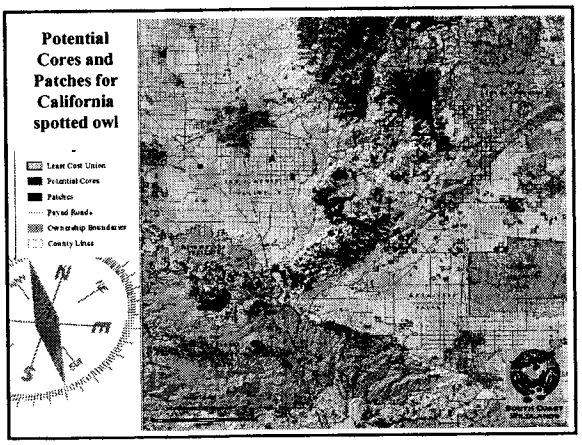


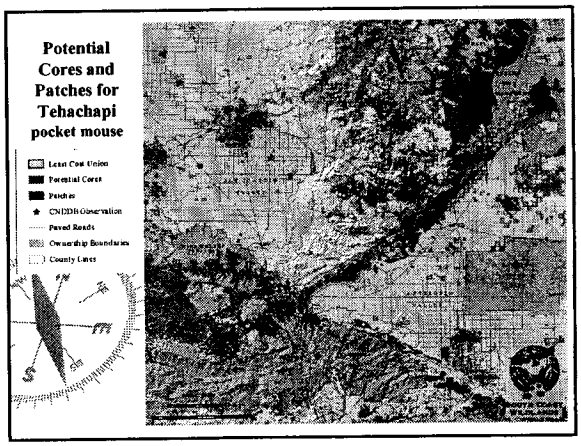
GOAL: Evaluate size and distance between suitable habitat patches in the Least-Cost Union for each focal species based on habitat quality, home range size, dispersal distance.

Potential Cores & Patches for San Joaquin kit fox



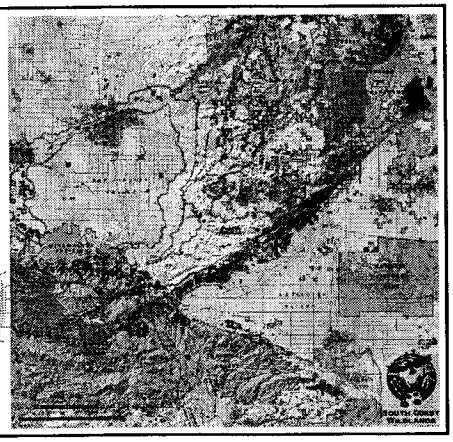

Potential Cores and Patches for Mule deer
Least Cost Union
Potential Cores
Patches
Paved Roads
Ownership Boundaries
County Lines


Potential Cores and Patches for California spotted owl
Least Cost Union
Potential Cores
Patches
Paved Roads
Ownership Boundaries
County Lines


Potential Cores and Patches for Tehachapi pocket mouse
Least Cost Union
Potential Cores
Patches
CNDDB Observation
Paved Roads
Ownership Boundaries
County Lines

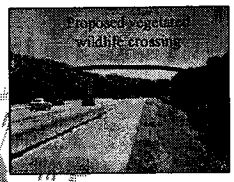
Patch Configuration for Tehachapi pocket mouse

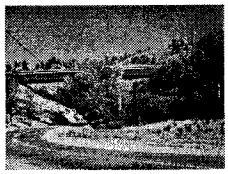
Colors signify patches of suitable habitat that are within a dispersal distance of 120 m

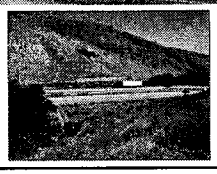


Field Work

Assess habitat quality, movement barriers and filters, and restoration opportunities.

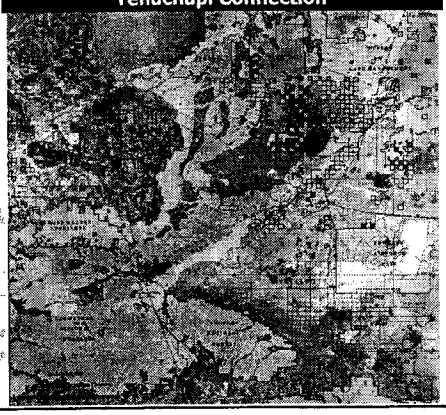






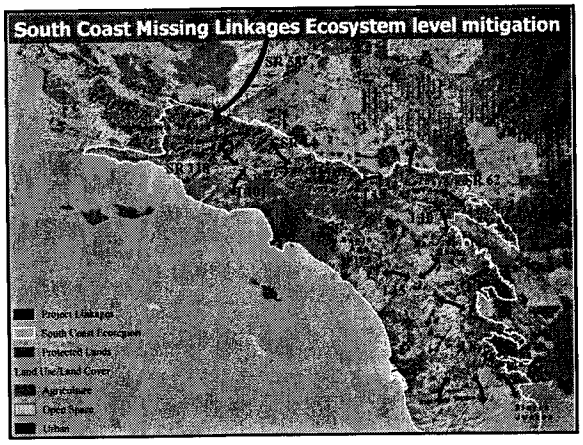
Goal: Improve connectivity, not just slow the losses!

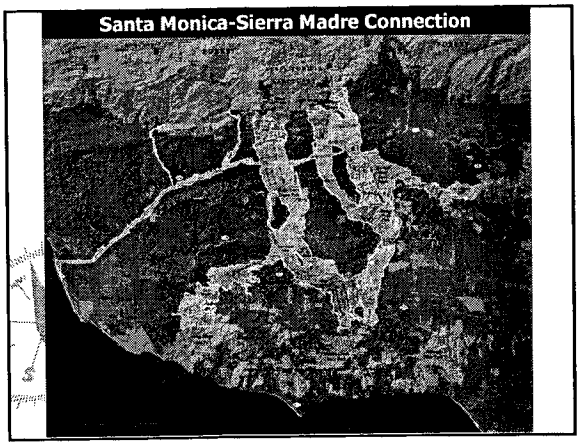
Tehachapi Connection



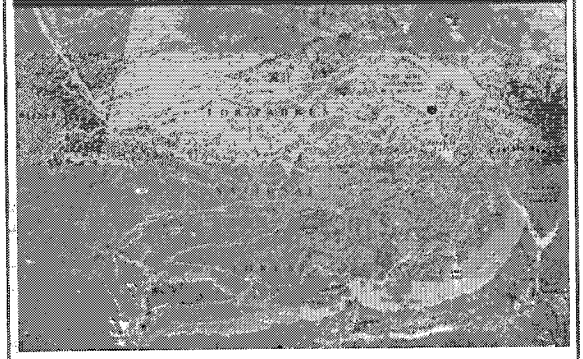
Goals of Each Linkage Design:

- Provide live in and move through habitat for multiple species.
- Support metapopulations of smaller species
- Ensure the availability of key resources
- Buffer against edge effects
- Allow natural process to operate
- Allow species and communities to respond to climatic changes

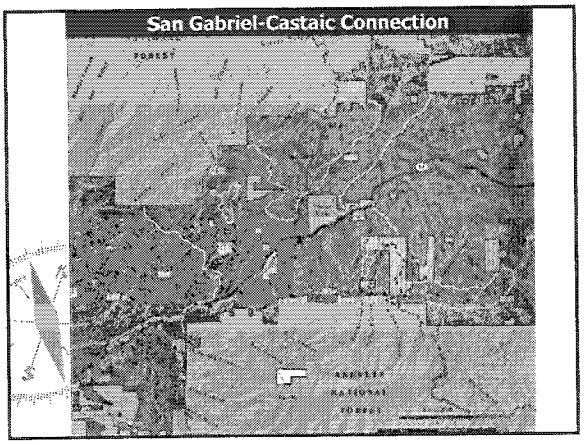




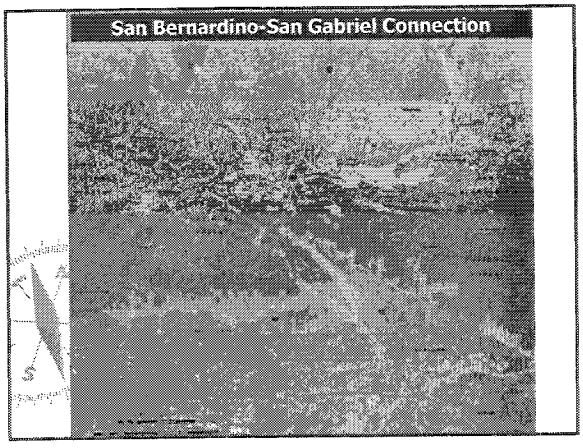
Sierra Madre-Castaic Connection

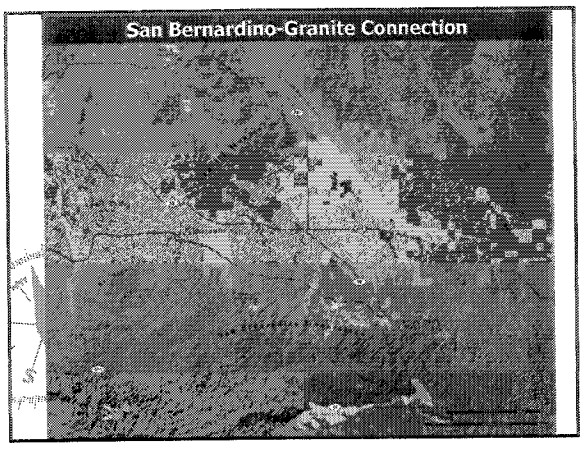


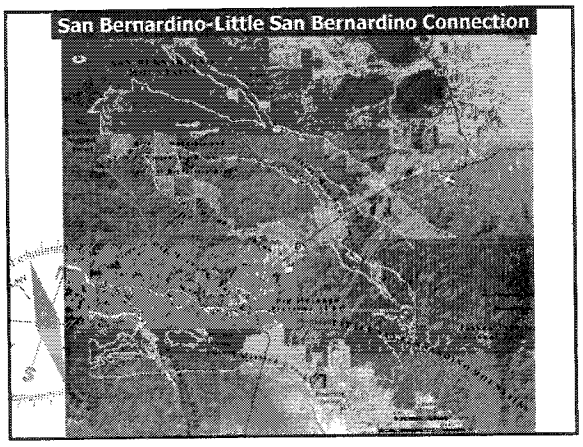
San Gabriel-Castaic Connection

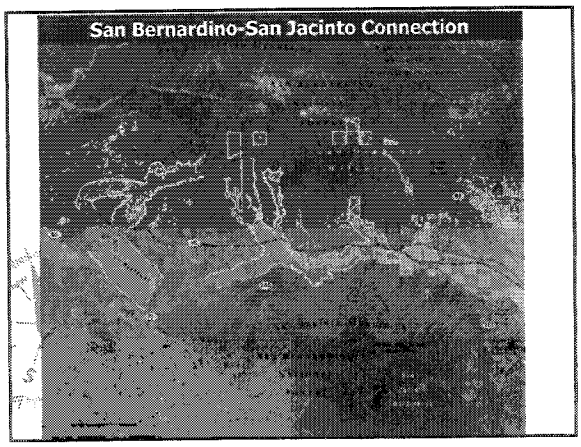


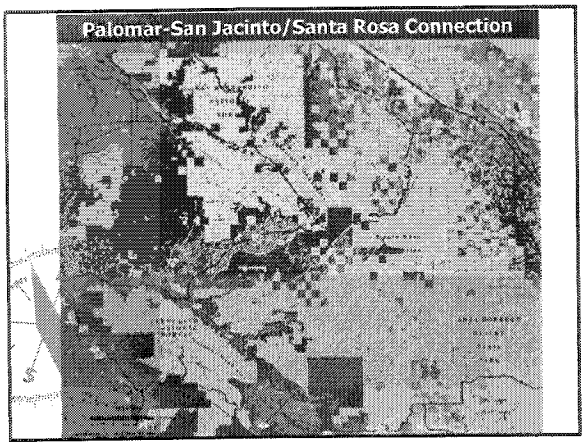
San Bernardino-San Gabriel Connection

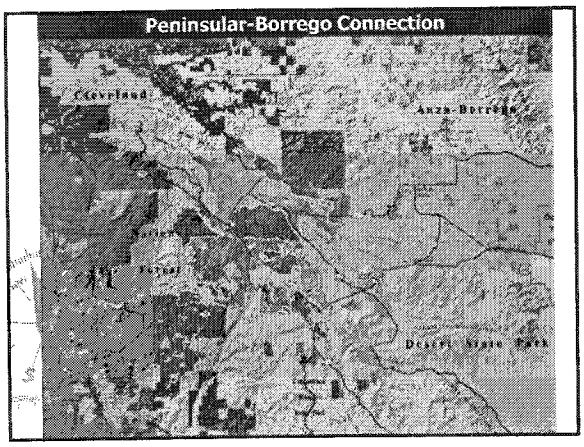


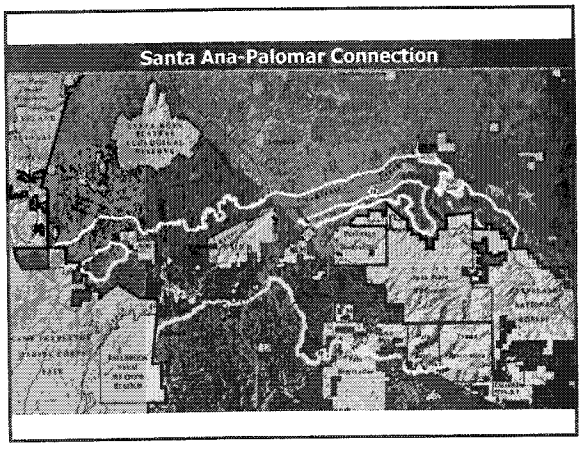

San Bernardino-Granite Connection

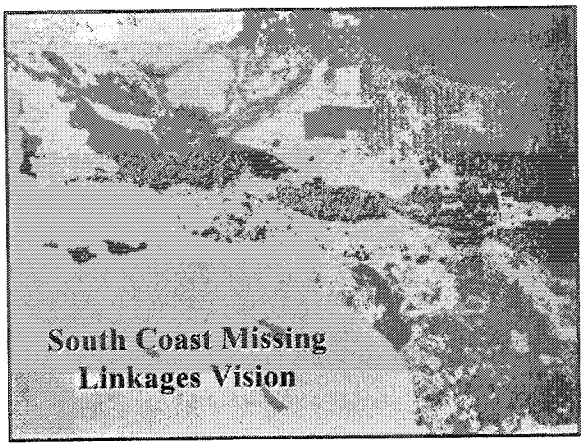

San Bernardino-Little San Bernardino Connection


San Bernardino-San Jacinto Connection


Palomar-San Jacinto/Santa Rosa Connection

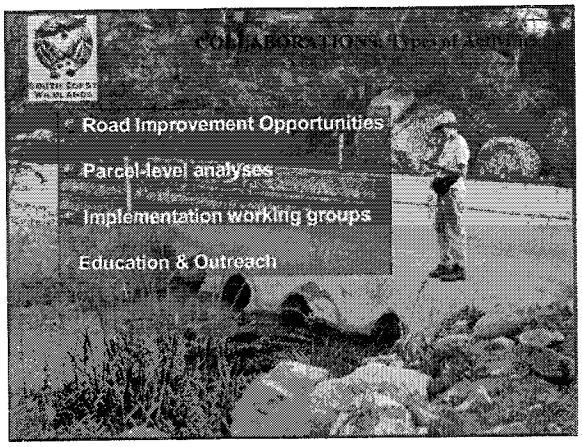

Peninsular-Borrego Connection

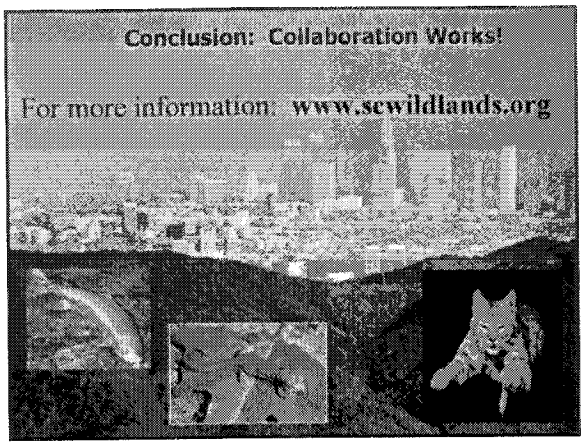

Santa Ana-Palomar Connection



Project Status:

- Communications Plan for Unveiling SCML vision.
- Results being actively incorporated into conservation plans by numerous partners and planning entities
- Approach being exported to other regions and states, including
  - Arizona
  - New Mexico
  - Colorado




Conclusion: Collaboration Works!
For more information: www.scwildlands.org

Attachment D: "Missing Linkages" Studies in the SCAG Region*

*Prepared by Paul Beier, Ph.D.
For copies of the "Missing Linkages" reports, go to www.scwildands.org.

California Missing Linkages

Species that once moved freely through a mosaic of natural vegetation types are now confronted with a man-made labyrinth of barriers, such as roads, homes, businesses, and agricultural fields that fragment formerly expansive natural landscapes. Movement patterns crucial to species survival are being altered rapidly. To counter these trends, California has initiated a systematic approach for identifying, protecting, and restoring functional connections across the landscape to allow essential ecological processes to continue operating as they have for millennia.

In November 2000, a coalition of conservation and research organizations (California State Parks, California Wilderness Coalition, The Nature Conservancy, Zoological Society of San Diego's Center for Reproduction of Endangered Species, and U.S. Geological Survey) launched a statewide interagency workshop at the San Diego Zoo entitled "Missing Linkages: Restoring Connectivity to the California Landscape". The workshop brought together over 200 land managers and conservation ecologists representing federal, state, and local agencies, academic institutions, and non-governmental organizations to identify "potential linkages" – that is, areas where natural connectivity is at risk. Of the 232 potential linkages identified at the workshop (Figure 1), 69 were associated with the South Coast Ecoregion and 46 were associated with the Mohave and Sonoran Deserts Ecoregion of southern California (Penrod et al. 2001).

Many of these potential linkages fall within the SCAG region (Figure 2) and are limited in several ways:

- Some important potential linkages may not have made it to the map. With no formal way to exhaustively list core areas, some possible pairs of core areas needing connectivity may not have been noticed.

- The potential linkages vary greatly in importance. For example, a potential linkage between 2 small, highly degraded wildlands is less important than a potential linkage between 2 large, intact wildlands.

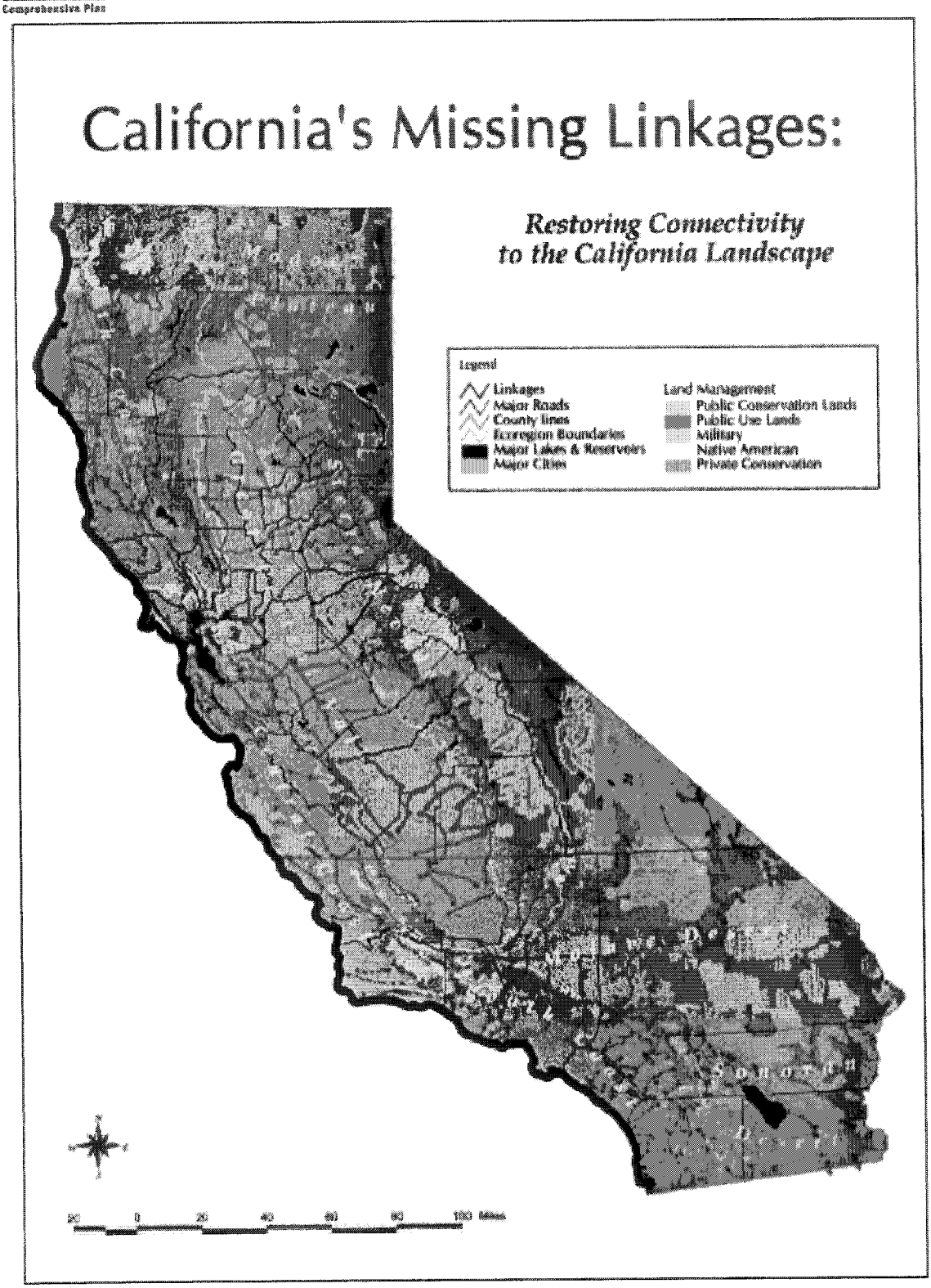


Figure 1. California Missing Linkages Map

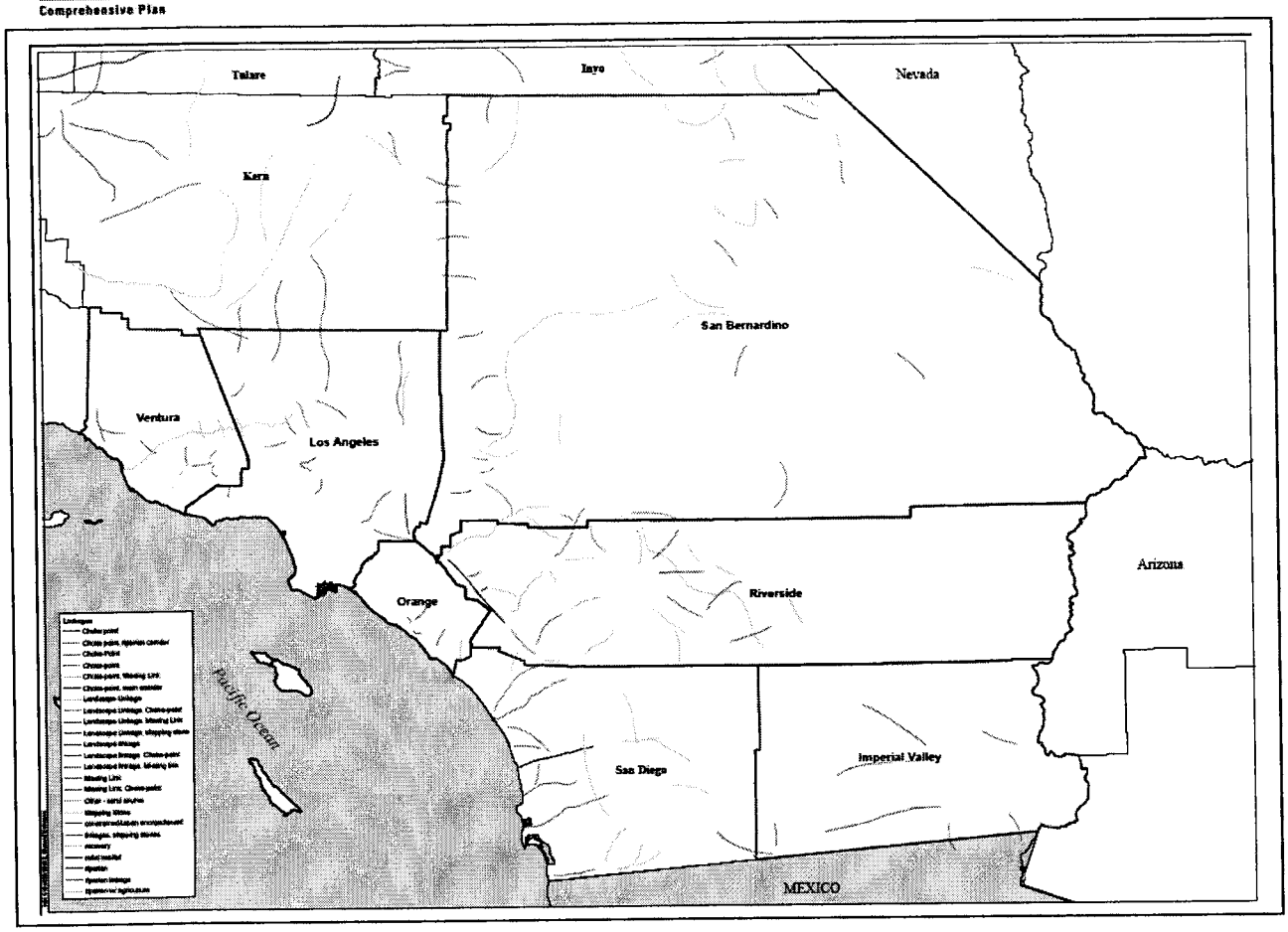


Figure 2. Potential linkages in and near the SCAG Region.

- Some potential linkages may have been permanently obstructed by human development at the time they were put on this list. Others may become obstructed since 2000.

- In some cases what was perceived as one core area in 2000 may now be perceived as 2 core areas delineated by potential barriers (roads, urbanization) that arose since 2000.

For these reasons, we offer a procedure for identifying core areas and potential linkages among them. Nonetheless the potential linkages indicated on the map form a useful reference list for SCAG by indicating areas where, in the opinion of experts familiar with this landscape, wildlife connectivity was both important and threatened.

Prioritizing Potential Linkages

Following the statewide Missing Linkages conference, South Coast Wildlands, a non-profit organization established to pursue habitat connectivity planning in the South Coast Ecoregion, brought together regional ecologists to conduct a formal evaluation of 69 linkages in the South Coast Ecoregion, most but not all of which fall in the SCAG region. The evaluation was designed to assess the biological irreplaceability and vulnerability of each linkage (*sensu* Noss et al. 2002). Irreplaceability assessed the relative biological value of each linkage, including both terrestrial and aquatic criteria: 1) size of habitat blocks served by the linkage; 2) quality of existing habitat in the smaller habitat block; 3) quality and amount of existing habitat in the proposed linkage; 4) linkage to other ecoregions or key to movement through the ecoregion; 5) facilitation of seasonal movement and responses to climatic change; and 6) addition of value for aquatic ecosystems. Vulnerability was evaluated using recent high-resolution aerial photographs, local planning documents, and other data concerning threats of habitat loss or fragmentation in the linkage area. This process identified 16 linkages of crucial biological value that are likely to be irretrievably compromised by development projects over the next decade unless immediate conservation action occurs; eleven of these linkages fall in the SCAG region (Figure 3).

Figure 3. Eleven Priority South Coast Ecoregion Linkages within the SCAG Region

From northwest to southeast the linkages are between:

- Sierra Madre Mountains and Castaic Ranges
- San Gabriel Mountains and Castaic Ranges,
- Santa Susana Mountains and Sierra Madre Mountains
- Santa Monica Mountains and Santa Susana Mountains

- San Bernardino Mountains and San Gabriel Mountains
- San Bernardino Mountains and Granite Mountains
- San Bernardino Mountains and Little San Bernardino Mountains
- San Bernardino Mountains and San Jacinto Mountains (highlighted in figure)
- Palomar Ranges and San Jacinto/Santa Rosa Mountains
- Santa Ana Mountains and Palomar Ranges,
- Peninsular Ranges and Anza Borrego

Note that the South Coast Ecoregion only partially overlaps the SCAG region. Thus these may not be the 11 most important linkages in the much larger SCAG region. The primary reason for mentioning these linkages is because detailed linkage designs exist for these 11 areas (see below).

Linkage Designs for 11 Potential Linkages in the SCAG Region

Identification of these priority linkages launched the South Coast Missing Linkages Project. This project is a highly collaborative effort among federal and state agencies and non-governmental organizations to identify and conserve landscape-level habitat linkages to protect essential biological and ecological processes in the South Coast Ecoregion. Partners include: South Coast Wildlands, The Wildlands Conservancy, The Resources Agency California Legacy Project, California State Parks, California State Parks Foundation, United States Forest Service, National Park Service, Santa Monica Mountains Conservancy, Rivers and Mountains Conservancy, Conservation Biology Institute, San Diego State University Field Stations Program, The Nature Conservancy, Southern California Wetlands Recovery Project, Environment Now, Mountain Lion Foundation, and the Zoological Society of San Diego's Conservation and Research for Endangered Species. Cross-border alliances have also been formed with Pronatura, Universidad Autonoma de Baja California, and Conabio.

South Coast Wildlands coordinated and hosted regional workshops, provided resources to these partners, and conducted GIS analyses for the 11 priority linkages. These 11 plans are available on the South Coast Wildlands website (www.scwildlands.org/), or by request from Kristeen Penrod or Paul Beier. Each report contains several common elements that may be of use to SCAG:

- Ecological Significance of the Linkage: A description of the biological resources in each core area connected by the linkage, and in the potential linkage area, highlighting rare or special-status species and biotic communities.

- Existing Conservation Investments: A list of the publicly-owned and privately-conserved wildlands that would be linked by a functioning corridor, with an emphasis on Wilderness Areas, National Parks or Monuments, and other areas managed predominantly for biological values.

- A list of focal species used to design the linkage. In each linkage area, 12-30 species were selected to represent the entire biotic community and ecological processes. Each linkage design is thus intended to be comprehensive.

- A map of the linkage design. The linkage is typically composed of 2-5 strands or braids, rather than being a single narrow band connecting the core areas. For instance the perennial streams may be joined in a long non-linear strand to serve fish, amphibians, and water-dependent species. A second band might consist of flat scrub and desert grassland to serve species like badgers and jackrabbits. A third strand might be dominated by rugged topography for species such as bighorn sheep. Each strand is broad to buffer against edge effects, such as weed invasion, artificial night lighting, predation by house pets, increases in opportunistic species like raccoons, elevated soil moisture from irrigation, pesticides and pollutants, noise, trampling, and domesticated animals that attract native predators. Width also reduces the risk that fires, floods, and other natural processes might affect the entire linkage simultaneously.

- A summary of land ownership, land cover, and topography in each strand of the linkage design.

- A description and photographs of major threats to wildlife movement, and specific recommendations to mitigate those barriers. These mitigation measures include recommendations for particular types of highway crossing structures at particular locations on major roads, canals, or railroads, recommendations for controlling urbanization, and recommendations for streams.

- A list of land protection and stewardship opportunities in the linkage design.

These reports can be used in the SCAG project to provide (a) detailed information on particular wildlife linkages, and/or (b) a template to ensure that future linkage designs provide similar information, or even more useful types of information.

Attachment E: Analytic Tools for Avoiding, Reducing, and Mitigating Impacts to Wildlife Linkages from Transportation Projects*

*This document is a working draft prepared by Paul Beier, Ph.D.

The impacts of roads[1] on wildlife are diverse (Spellerberg 1998, Forman & Alexander 1998, Forman et al. 2003). In this document, we ignore impacts due to pollution (from combustion, de-icing agents, construction materials), loss of habitat due to the area occupied by the road or urban growth induced by the road, exotic plant species that spread from rights-of-way into wildlands, edge effects due to noise & artificial night lighting, and indirect impacts due to altered hydrology and increased erosion near the road. Although these impacts can be substantial, here we focus on how roads impact the ability of wildlife to move between the remaining wildlands on either side of the road (Table 1).

Table 1. Impacts of roads on wildlife corridors and wildland connectivity, with appropriate mitigations for various types of impacts.

Impact	Appropriate Mitigations
barrier to within-population movement	• crossing structures • conserve habitat leading from each crossing structure to remaining wildlands
barrier to recolonization	
barrier to gene flow	
barrier to seasonal migration	
barrier to ecological processes such as pollination, seed dispersal, predator-prey interactions, nutrient cycling, and shifting geographic range in response to climate change.	• As above, but habitat corridor must be broad and must contain diverse soils & topography to enable entire communities to shift.
mortality due to collisions with vehicles	• roadside fencing (must be integrated with crossing structures)

The main significant impacts of roads on wildlife linkages are several types of barrier effects and direct mortality of animals attempting to cross the road:

- **Barrier to within-population movement:** When a formerly large area of habitat is dissected by roads, it may become impossible for individual animals to move across the road between the remaining wild areas. Thus a 1000-acre area may become two 500-acre areas isolated from each other, and each wildlife population becomes two, smaller, populations. These small areas may be too small to support a population of some wildlife species. The impact is particularly severe for area-sensitive species – that is, species that need a large area to support a population, such as mountain lions, bears, deer, bighorn, badgers, and other large and medium-sized mammals. As a result, populations become demographically unstable and eventually become extinct in each patch.

- **Barrier to recolonization:** Species may become extinct in local areas for a variety of reasons. If migrants can re-colonize the area by moving from nearby habitat, extinction will be temporary. However roads can preclude such recolonization.

- **Barrier to gene flow:** Until recently, most scientists believed it would take at least a century for roads to cause measurable genetic divergence in wildlife populations, especially for long-lived species in which genetic change occurs slowly. However, 2 recent studies, both conducted in the SCAG region, provide the first scientific evidence that 40- to 50-year-old highways profoundly decrease gene flow in large mammals, namely bighorn sheep (Epps et al. 2005) and bobcats and coyotes (Riley et al. 2006).

- **Barrier to seasonal movement:** In the SCAG region, probably only a few large mammal populations migrate between wintering and summer areas. Where such migration occurs, it is critically important that highways have vegetated overpasses or bridged undercrossings to allow mammals to migrate (Berger 2004). Although many birds in the SCAG region migrate, migratory birds can fly across unsuitable habitat and are probably not affected by highways.

- **Barrier to ecological processes** such as pollination, seed dispersal, predator-prey interactions, and nutrient cycling, and shift of geographic range: Of these processes, the ability of animals and natural communities to shift their geographic range is of particular importance, because range shift it the only way (other than extinction) that species and natural communities can respond to climate change. Mitigation for this type of barrier effect will requires a broad linkage.

1 We use the term "road" or "highway" as shorthand for any linear transportation project, including freight rail, high-speed rail, and aqueducts in addition to highways.

- **Mortality of animals attempting to cross roads:** Severe impacts have been documented on the cougar in southern California, the Florida panther, the ocelot, the wolf, and the Iberian lynx (Forman et al. 2003). In a 4-year study of 15,000 km of road observations in Organ Pipe Cactus National Monument, Rosen and Lowe (1994) found a minimum of 22.5 snakes per km per year killed due to vehicle collisions. Using a more frequent monitoring in an area of high turtle density, Aresco (2005) found 11.9 turtles killed per km *per day* along a 4-lane highway in Florida. This impact can be addressed by fencing that prevents an animal from entering the roadway, which can reduce mortality of animals by 80% to 99% (Clevenger et al. 2001a, Dodd et al. 2004, Aresco 2005). However, fencing alone is not a satisfactory solution because it increases the barrier effects listed above – unless the fencing is integrated with other types of mitigations (such as highway crossing structures and conservation of land in the linkage).

The impacts listed above can be avoided, minimized, and mitigated by 2 types of mitigation (Table 1, Table 2), namely crossing structures integrated with roadside fencing, and conserving habitat between crossing structures and affected wildlands. Although there are few scientific studies documenting the effectiveness of underpasses and overpasses in facilitating wildlife movement, there is a clear pattern emerging from those studies, such that it is possible to propose a set of best management practices for crossing structures. GIS tools are needed to identify lands to conserve in the vicinity of road crossing structures (Table 2).

Table 2. The two main types of mitigation for transportation projects

Type of Mitigation	Notes
Crossing structures integrated with roadside fencing	A cookbook set of best management practices (diversity of structures, with 300m spacing between small structures, 1 mile spacing between large structures, design guidelines for structures) is sufficient when a road bisects protected wildland (i.e., habitat is already conserved).
Conserve habitat leading from each crossing structure to remaining wildlands	If developable land occurs in the wildlife linkage, GIS analysis can identify which land to conserve. To date, most such GIS analyses have concerned particular focal species, but it is better for linkages to serve multiple species and to accommodate ecological processes, such as the ability of species to shift their range in response to climate change.

Best Management Practices for Road Crossing Structures

Wildlife crossing structures that have been used in North America and Europe to facilitate movement through landscapes fragmented by roads include wildlife overpasses & green bridges, bridges, culverts, and pipes (Figure 1). While many of these structures were not originally constructed with ecological connectivity in mind, many species benefit from them (Clevenger et al. 2001; Forman et al. 2003). No single crossing structure will allow all species to cross a road. For example rodents prefer to use pipes and small culverts, while bighorn prefer vegetated overpasses or open terrain below high bridges. A concrete box culvert may be readily accepted by a mountain lion or bear, but not by a deer or bighorn sheep. Small mammals, such as deer mice and voles, prefer small culverts to wildlife overpasses (McDonald & St Clair 2004).

Wildlife overpasses are most often designed to improve opportunities for large mammals to cross busy highways. Approximately 50 overpasses have been built in the world, with only 6 of these occurring in North America (Forman et al. 2003). Overpasses are typically 30 to 50 m wide, but can be as large as 200 m wide. In Banff National Park, Alberta, grizzly bears, wolves, and all ungulates (bighorn sheep, deer, elk, and moose) prefer overpasses to underpasses, while species such as mountain lions prefer underpasses (Clevenger & Waltho 2005).

Wildlife underpasses include viaducts, bridges, culverts, and pipes, and are often designed to ensure adequate drainage beneath highways. For ungulates such as deer, tall, wide bridges are best. Mule deer in southern California only used underpasses below large spanning bridges (Ng et al. 2004) and the average size of underpasses used by white-tailed deer in Pennsylvania was 15 ft wide by 8 ft high (Brudin 2003). Because most small mammals, amphibians, reptiles, and insects need vegetative cover for security, bridged undercrossings should extend to uplands beyond the scour zone of the stream, and should be high enough to allow enough light for vegetation to grow underneath. In the Netherlands, rows of stumps or branches under crossing structures have increased connectivity for smaller species crossing bridges on floodplains (Forman et al. 2003).

Figure 1. Potential road mitigations (from top to bottom) include: highway overpasses, bridges, culverts, and drainage pipes. Fencing (lower right) should be used to guide animals into crossing structures.

Drainage culverts can mitigate the effects of busy roads for small and medium sized mammals (Clevenger et al. 2001; McDonald & St Clair 2004). Culverts and concrete box structures are used by many species, including mice, shrews, foxes, rabbits, armadillos, river otters, opossums, raccoons, ground squirrels, skunks, coyotes, bobcats, mountain lions, black bear, great blue heron, long-tailed weasel, amphibians, lizards, snakes, and southern leopard frogs (Yanes et al. 1995; Brudin III 2003; Dodd et al. 2004; Ng et al. 2004). Black bear and mountain lion prefer less-open structures (Clevenger & Waltho 2005). In south Texas, bobcats most often used 1.85 m x 1.85 m box culverts to cross highways, preferred structures near suitable scrub habitat, and sometimes used culverts to rest and avoid high temperatures (Cain et al. 2003). Culvert usage can be enhanced by providing a natural substrate bottom, and in locations where the floor of a culvert is persistently covered with water, a concrete ledge established above water level can provide terrestrial species with a dry path through the structure (Cain et al. 2003). It is important for the lower end of the culvert to be flush with the surrounding terrain. Many culverts are built with a concrete pour-off of 8-12 inches, and others develop a pour-off lip due to scouring action of water. A sheer pour-off of several inches makes it unlikely that many small mammals, snakes, and amphibians will find or use the culvert.

Several sets of best management practices related to roads have been published recently (National Cooperative Highway Research Program 2004, Riverside County 2004, National Research Council 2005). There are only a few scientific studies to support these guidelines, and most designs are based on understanding of animal behavior with few data on efficacy of the design. However, the existing literature clearly suggests that almost any crossing structure will be useful to at least some wildlife species, that a variety of structures interspersed along a highway will be useful to many wildlife species, and that steep pour-offs and debris can ruin an otherwise useful structure.

In light of this consensus, the following 9 recommendations provide a set of best management practices that can be applied throughout the SCAG ecoregion. In an area where a road crosses wildland that is protected from development, following these guidelines should mitigate most of the road impact on wildlife movement. However the additional step of GIS analysis (next section) is necessary in areas where multiple roads have cumulative impacts, or developable land occurs between the road and protected wildlands.

1. **Multiple crossing structures should be constructed at a crossing point to provide connectivity for all species likely to use a given area (Little 2003).** Different species prefer different types of structures (Clevenger et al. 2001; McDonald & St Clair 2004; Clevenger & Waltho 2005; Mata et al. 2005). For deer or other ungulates, an open structure such as a bridge is crucial. For medium-sized mammals, black bear, and mountain lions, large box culverts with a natural earthen substrate flooring are optimal (Evink 2002). For small mammals, pipe culverts from 0.3m – 1 m in diameter are preferable (Clevenger et al. 2001; McDonald & St Clair 2004). Maintain a height of 3 m and an appropriate openness ratio of at least 0.6 for crossings intended for use by mule deer; calculate this ratio as opening width x opening height/length of crossing (Riverside County 2004).

2. **At least one crossing structure should be located within an individual's home range.** Because most reptiles, small mammals, and amphibians have small home ranges, metal or cement box culverts should be installed at intervals of 150-300 m (Clevenger et al. 2001). For ungulates (deer, pronghorn, bighorn) and large carnivores, larger crossing structures such as bridges, viaducts, or overpasses should be located no more than 1.5 km (0.94 miles) apart (Mata et al. 2005; Clevenger and Wierzchowski 2006). Inadequate size and insufficient number of crossings are two primary causes of poor use by wildlife (Ruediger 2001).

3. **Suitable habitat for species should occur on both sides of the crossing structure** (Ruediger 2001; Barnum 2003; Cain et al. 2003; Ng et al. 2004). This applies to both *local* and *landscape* scales. On a local scale, vegetative cover should be present near entrances to give animals security, and reduce negative effects such as lighting and noise associated with the road (Clevenger et al. 2001; McDonald & St Clair 2004). A lack of suitable habitat adjacent to culverts originally built for hydrologic function may prevent their use as potential wildlife crossing structures (Cain et al. 2003). On the landscape scale, "Crossing structures will only be as effective as the land and resource management strategies around them" (Clevenger et al. 2005). Suitable habitat must be present throughout the linkage for animals to use a crossing structure.

4. **Whenever possible, suitable habitat should occur *within* the crossing structure.** This can best be achieved by having a bridge high enough to allow enough light for vegetation to grow under the bridge, and by making sure that the bridge spans upland habitat that is not regularly scoured by floods. Where this is not possible, rows of stumps or branches under large span bridges can provide cover for smaller animals such as reptiles, amphibians, rodents, and invertebrates; regular visits are needed to replace artificial cover removed by flood. Within culverts, earthen floors are preferred by mammals and reptiles.

5. **Structures should be monitored for, and cleared of, obstructions such as detritus or silt blockages that impede movement.** Small mammals, carnivores, and reptiles avoid crossing structures with significant detritus blockages (Yanes et al. 1995; Cain et al. 2003; Dodd et al. 2004). In the southwest, over half of box culverts less than 8 x 8 ft have large accumulations of branches, Russian thistle, sand, or garbage that impede animal movement (Beier, personal observation). Bridged undercrossings rarely have similar problems.

6. **Fencing should never block entrances to crossing structures, and instead should direct animals towards crossing structures** (Yanes et al. 1995). In Florida, construction of a barrier wall to guide animals into a culvert system resulted in 93.5% reduction in roadkill, and also increased the total number of species using the culvert from 28 to 42 (Dodd et al. 2004). Fences, guard rails, and embankments at least 2 m high discourage animals from crossing roads (Barnum 2003; Cain et al. 2003; Malo et al. 2004). In an area with no large animals, a 3-foot wall with an 18-inch lip projecting into the adjacent open space can direct small wildlife toward crossing structures (Riverside County 2004). One-way ramps on roadside fencing can allow an animal to escape if it is trapped on a road (Forman et al. 2003).

7. **Raised sections of road discourage animals from crossing roads, and should be used when possible to encourage animals to use crossing structures.** Clevenger et al. (2003) found that vertebrates were 93% less susceptible to road-kills on sections of road raised on embankments, compared to road segments at the natural grade of the surrounding terrain.

8. **Manage human activity near each crossing structure**. Clevenger & Waltho (2000) suggest that human use of crossing structures should be restricted and foot trails relocated away from structures intended for wildlife movement. However, a large crossing structure (viaduct or long, high bridge) should be able to accommodate both recreational and wildlife use. Furthermore, if recreational users are educated to maintain utility of the structure for wildlife, they can be allies in conserving wildlife corridors. At a minimum, nighttime human use of crossing structures should be restricted.

9. **Design culverts specifically to provide for animal movement**. Most culverts are designed to carry water under a road and minimize erosion hazard to the road. Culvert designs adequate for transporting water often have pour-offs at the downstream ends that prevent wildlife usage. At least 1 culvert every 150-300m of road should have openings flush with the surrounding terrain, and with native land cover up to both culvert openings, as noted above.

GIS Procedures to Prioritize Conservation Land within a Linkage

Building a set of excellent highway underpasses and overpasses integrated with roadside fencing will not mitigate impacts to wildlife movement if the land between the highway and the nearest wildland is converted to urban uses or other uses incompatible with wildlife occupancy or movement. The goal of GIS analysis is to identify a continuous corridor of land which – if conserved and integrated with underpasses or overpasses across potential barriers – will best maintain or restore the ability of wildlife to move between large protected habitat blocks. Following Beier et al. (2006), we call this proposed corridor a *Linkage Design.*

Noss & Daly (2006) discuss alternative approaches to linkage design. At the low-tech end of the spectrum are what Noss and Daly call "seat of the pants" approaches. These approaches might involve selecting the only remaining route between 2 areas, the most direct route, the route with the largest parcels and willing sellers, the route that incorporates parcels of interest to investors, and a route based on the opinion of a species expert. All of these approaches can be appropriate and effective under some conditions. For instance, the Coal Canyon Biological Corridor, which was added to Chino Hills State Park in 2000, was the only remaining route between the Chino Hills and the Santa Ana Mountains for any wildlife species, and consisted of only 3 parcels. In this case, a seat of the pants approach was appropriate.

Noss and Daly also describe empirical an modeling approaches to linkage design; these are preferred to seat of the pants approaches when the length of the potential corridor is not fully constrained by existing urban barriers. If planners wish to conserve multiple focal species, GIS analyses such as least cost corridor analysis and spatially-explicit population models are the appropriate tools.

Like all models, GIS procedures involve uncertainty and simplifying assumptions, and therefore do not produce absolute "truth" but rather an estimate or prediction of the optimal wildlife corridor. Despite this limitation, there are several reasons to use models instead of maps hand-drawn by species experts or other intuitive approaches:

1. Developing the model forces important assumptions into the open.
2. Using the model makes us explicitly deal with interactions (e.g., between species movement mobility and corridor length) that might otherwise be ignored.
3. The model is transparent, with every algorithm and model parameter available for anyone to inspect and challenge.
4. The model is easy to revise when better information is available.

There are many GIS approaches that can develop a Linkage Design, but, except for the *Least Cost Path* tool in ArcGIS, there are no standardized, named approaches. Even the *Least Cost Path* tool assumes the analyst has developed a cost-surface layer, for which there is no standard approach. About 15 scientific papers – all published in the last 10

years – use GIS procedures to develop a Linkage Design (Walker & Craighead 1997, Quinby et al. 1999, Hoctor et al. 2000, Graham 2001, Servheen et al. 2001, Bani et al. 2002, Schadt et al. 2002, Singleton et al. 2002, Joly et al. 2003, Sutcliffe et al. 2003, Kramer-Schadt et al. 2004, Wikramanayake et al. 2004, Marulli and Mallarach 2005, Williams et al. 2005, Beier et al. 2006). However, each paper focuses on the resulting Linkage Design - the GIS procedures are never the main point of the paper. Indeed, no paper fully explains the many choices made during the analysis.

In Figure 2 we provide a flow chart illustrating most of the options involved in creating a GIS-based Linkage Design[2]. Some of the options are conceptually possible, but have not been put into practice. Other choices probably have little impact on the Linkage Design; however, except for Newell and Beier (In Prep), no published sensitivity analyses address how these choices affect the ultimate map. Here we briefly discuss the choices; the numbers below correspond to numbers in the flow chart (Figure 2).

1. Almost all studies estimate travel cost using literature review and expert opinion. There are potential alternatives, but to date they are untested and perhaps not feasible: (a) Gerlach and Musolf (2000) and Epps et al. (2005), respectively, used genetic analysis to estimate the travel cost of rivers on vole movement and of highways on bighorn movement. However, their analyses assumed that each pixel of matrix could be assigned to one of two cost classes (one for the river or highway, one for all other matrix pixels). Their approach would not yield unique estimates if the matrix were modeled as having multiple classes. (b) Travel cost could theoretically be measured from documented rates of interpatch movement (e.g., Sutcliffe et al. 2003). However if the landscape contains more than a handful of habitat classes, thousands of combinations of costs are consistent with the observed interpatch movement or genetic patterns (Sutcliffe et al. 2003). Furthermore, unless the researcher samples the entire geographic range of the species or metapopulation, estimates will be distorted due to (unmeasured) movements or gene flow from patches outside the study area but within the interacting group of patches. (c) Individual-based movement models are another promising alternative, but so far have been used only in a landscape with 150-m long corridors (Levey et al. 2005), and have not been used to estimate travel cost.

2 This figure and much of the related discussion will form the basis of a paper in preparation by Beier and colleagues. Ovals indicate choices the analyst must make. Line 2 lists land cover, elevation, topography, and distance to roads (or road density) as the driving factors, but the analyst may use only a subset of these, or may add other factors if GIS coverage is available.

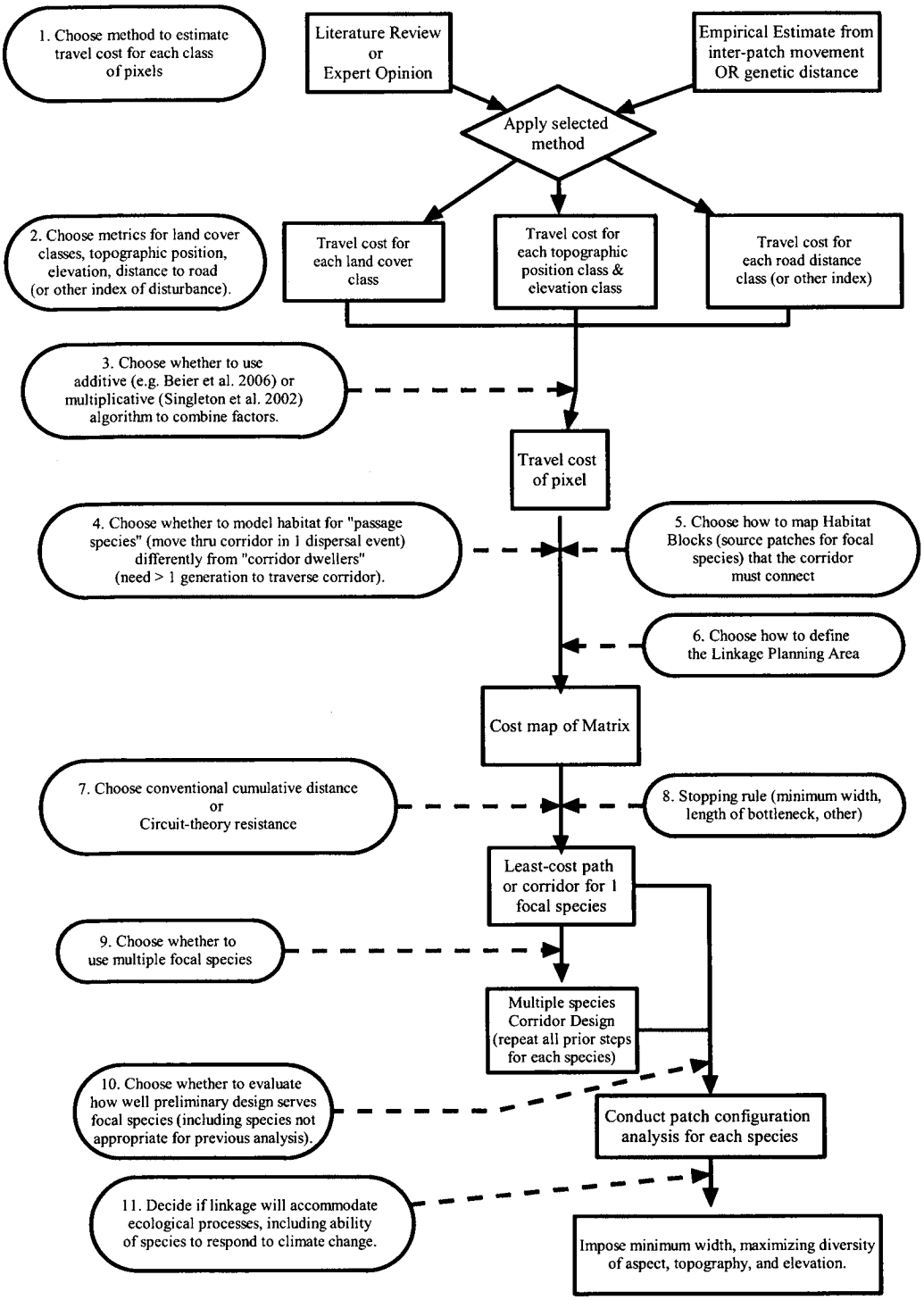


Figure 2. Generalized flow chart for GIS-based corridor design.

2. Typically, GIS models predict travel cost based on some or all of 4 factors: land cover (vegetation and land use classes), elevation, topography, and proximity to roads. Theoretically, one could use other factors but in practice, these are the only 4 widely-available GIS layers. Once the factors are selected, the analyst estimates the cost associated with each class using the method selected in #1. Newell and Beier (in prep) found that uncertainty in the cost estimates did not greatly affect the predicted best corridor of most species, but had an enormous impact for a few species.

3. The cost scores for land cover, elevation, proximity to roads, and topography can be combined as a weighted sum or a weighted product. The multiplicative model better reflects the possibility that one factor (e.g., proximity to roads) may limit wildlife movement in a way that cannot be compensated by a better score for another factor (e.g., land cover). Beier and Majka (Northern Arizona University, personal observation) find that this choice does not have a major impact on the Linkage Design.

4. Only Beier and colleagues (in 8 linkage designs produced for Arizona Game and Fish Department in 2006) have added a special procedure to model movement by species that require multiple generations to move through a corridor. Their procedure assigns an arbitrarily low travel cost to any group of contiguous pixels of sufficient quality and size to support breeding by the focal species. This procedure tends to produce a corridor that runs between steppingstones of breeding habitat, and substantially improves the Linkage Design. Although a similar improvement can be achieved via Patch Configuration Analysis (#10), recognizing the value of breeding patches early in the analysis is more efficient and less subjective.

5. The Linkage Design is profoundly affected by how the analyst delineates the habitat patches to be linked. The analyst might choose to have the linkage connect only to lands with the strongest conservation mandate, such as designated wilderness areas, Research Natural Areas, and Preserves managed by The Nature Conservancy. The analyst might also delineate habitat blocks to include National and State Parks, National Forest land, BLM land, military land, Bureau of Reclamation Land, and Native American reservations. There is no "right" answer to this issue but it seems reasonable that the areas to be connected should be likely to remain wild for at least 50 years. A closely related issue is whether the corridor for a single species should connect to any part of the protected habitat block (a common practice), or only to a large patch of suitable breeding habitat within the protected habitat. The latter seems more reasonable and involves relatively little additional work, and is standard on Linkage Designs produced by South Coast Wildlands and the Arizona Missing Linkages project at Northern Arizona University.

6. The GIS analyst cannot consider all possible travel paths on the planet, continent, or ecoregion, but is limited to a (usually rectangular) analysis area. Cumulative travel cost is calculated only for pixels within this Linkage Planning Area. As long as the Linkage Planning Area includes the boundary of each habitat block that "faces" the other habitat block and does not exclude any patches of high-quality habitat for the focal species, practitioners assume that this decision has little impact on the linkage design.

7. A circuit-theory resistance model was recently developed to model gene flow via multiple pathways (McRae, In Press), but has not yet been applied to Linkage Designs. It has some theoretical advantages and may become a useful tool in the future.

8. The swath of pixels with the lowest ecological cost is the best corridor for each species. However, the analyst must choose how wide the swath needs to be. The Least Cost Path tool in ArcGIS can identify a strand exactly one pixel wide between the habitat blocks – clearly too narrow to serve most species. An arbitrary minimum width (say ¼ mile) seems attractive, but often exceptions must be made for existing bottlenecks, such as those created by existing urban areas. Regardless of what rule is selected to stop adding pixels to the corridor, this is a labor-intensive part of the process, as the procedure cannot be fully automated, but must be done interactively.

9. Thus far, the procedure produces a biologically-best corridor for a single species. In most cases, conservation planners will want to design a corridor to serve multiple species and ecological processes. Analyzing a southern California linkage designed using 8 focal species, Newell and Beier (in prep.) found that the single-species corridors for carnivores (mountain lion, badger, and kit fox) were not good umbrellas for the other 5 species – there was no substitute for multi-species modeling if one wants to ensure connectivity for multiple species.

10. The GIS procedure will always produce a biologically best corridor – even if the best corridor is entirely inadequate for the focal species. Some sort of spatially-explicit population model is needed to evaluate the biologically best corridor. Beier and colleagues developed "patch configuration analysis" as a relatively simple procedure for this purpose. The procedure basically maps patches of habitat of high quality (breeding) habitat large enough to support breeding pairs and small populations, and overlays these on the draft corridor design. The analyst evaluates these patches with respect to the species dispersal distance and the draft corridor design.

11. Impose a minimum width. Wide linkages are beneficial because they (1) provide adequate area for development of metapopulation structures necessary to allow corridor-dwelling species (individuals or genes) to move through the landscape; (2) reduce pollution into aquatic habitats; (3) reduce edge effects such as pets, lighting, noise, nest predation & parasitism, and invasive species; (4) provide an opportunity to conserve natural fire regimes and other ecological processes; and (5) improve the opportunity of biota to respond to climate change

Illustration: Approach Used by South Coast Missing Linkages and Arizona Wildlife Linkage Workgroup

These 11 analytic decisions (Figure 2) can give rise to a very large number of alternative GIS approaches. One approach has been used by South Coast Wildlands and 25 partners in the South Coast Missing Linkages project to design 16 linkages in southern California during 2001-2006. This approach has been modified for use in 24 linkage designs in the state of Arizona by the Arizona Wildlife Linkage Workgroup during 2005-2008. We outline that approach in this section. To provide a consistent tense and minimize length, the description is written as a set of instructions (do this, then do this).

The approach uses GIS approaches to identify optimal travel routes for focal species representing the ecological community in the area. By carefully selecting a diverse group of focal species and capturing a range of topography to accommodate climate change, the Linkage Design should ensure the long-term viability of all species in the protected areas. The approach includes the following steps:

1. Select focal species.
2. Create a habitat suitability model for each focal species.
3. Join pixels of suitable habitat to identify potential breeding patches & potential population cores (areas that could support a population for at least a decade).
4. Identify the biologically best corridor (BBC) through which each species could move between protected core areas. Join the BBCs for all focal species.
5. Ensure that the union of BBCs includes enough population patches and cores to ensure connectivity for the focal species.
6. Expand the linkage to a minimum width.
7. Carry out field visits to identify barriers to movement and the best locations for underpasses or overpasses within Linkage Design area.

Focal Species Selection

Use a focal species approach (Lambeck 1997) to represent the needs of the ecological community within the potential linkage area. Invite regional biologists familiar with the region to identify 10-20 species with one or more of the following characteristics:

- habitat specialists, especially habitats that may be relatively rare in the potential linkage area.
- species sensitive to highways, canals, urbanization, or other potential barriers in the potential linkage area, especially species with limited movement ability.
- area-sensitive species that require large or well-connected landscapes to maintain a viable population and genetic diversity.
- ecologically important species such as keystone predators, important seed dispersers, herbivores that affect vegetation, or species that are closely associated with nutrient cycling, energy flow, or other ecosystem processes.
- species listed as threatened or endangered under the Endangered Species Act, or species of special concern to Arizona Game and Fish Department, US Forest Service, or other management agencies.

Construct corridor models for some, but not all, focal species. Do not model species for which there are insufficient data to quantify habitat use in terms of available GIS data (e.g., some snakes that select small rocks), or if the species probably can travel (e.g., by flying) across unsuitable habitat.

Habitat Suitability Models

Create habitat suitability models (Appendix A) for each species by estimating how the species responds to four habitat factors mapped at a 10x10m or 30x30 m level of resolution (Figure 3):

- *Vegetation and land cover.* Use the best seamless map available. If desired, merge some classes to create <50 vegetation & land cover classes.
- *Elevation:* the USGS National Elevation Dataset digital elevation model.
- *Topographic position.* Characterized each pixel as ridge, canyon bottom, flat to gentle slope, or steep slope.

- *Straight-line distance from the nearest paved road or railroad.* Distance from roads reflects risk of being struck by vehicles as well as noise, light, pets, pollution, and other human-caused disturbances. Either road density or distance to road can be used. There are problems with each.

To create a habitat suitability map, assign each of the 46 vegetation classes (and each of 4 topographic positions, and each of several elevation classes and distance-to-road classes) a score from 1 (best) to 10 (worst), where 1-3 is optimal habitat, 4-5 is suboptimal but usable habitat, 6-7 may be occasionally used but cannot sustain a breeding population, and 8-10 is strongly avoided. Whenever possible, recruit biologists with the greatest expertise in each species to assign these scores. If no expert is available for a species, three biologists independently assign scores and, after discussing differences among their individual scores, adjust their scores before the three scores are averaged. Regardless of whether the scores were generated by a species expert or project staff, the scorer should review the literature on habitat selection by the focal species before assigning scores[3].

This scoring produces 4 scores (land cover, elevation, topographic position, distance from roads) for each pixel, each score being a number between 1 and 10. Then weight each of the 4 factors by a weight between 0% and 100%, subject to the constraint that the 4 weights must sum to 100%, and add the 4 weighted scores to produce an overall habitat suitability score, also scaled 1-10. Use these habitat suitability scores to create a habitat suitability map that form the foundation for the later steps.

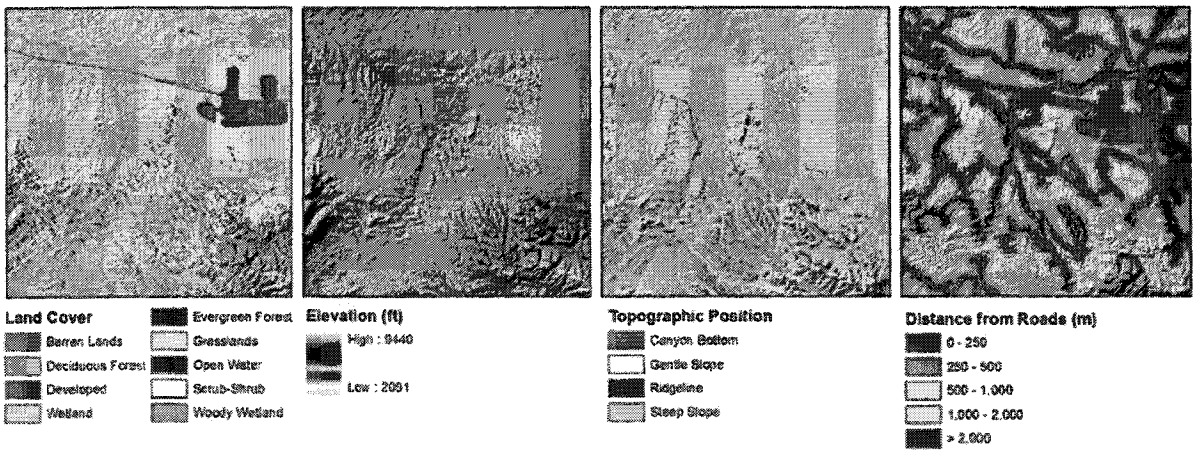


Figure 3: Four habitat factors used to create habitat suitability models. Inputs included vegetation, elevation, topographic position, and distance from roads.

3 Clevenger et al. (2002) found that literature review significantly improved the fit between expert scores and later empirical observations of animal movement.

If necessary, use additional factors critical for a particular species, such as a minimum slope needed as escape terrain for bighorn sheep, or proximity to water for frogs. To create a habitat suitability model using critical features, reclassify any pixel beyond a specified threshold distance from the critical feature as unsuitable for breeding (score > 5). This is accomplished by the equation:

New habitat score for pixel beyond threshold distance = (½ of original habitat score) + 5

Therefore, if a pixel of habitat *beyond* the threshold distance from a critical feature had an original habitat score of 1 (optimal habitat), it receives a reclassified score of 5.5 (usable, but not breeding habitat). Likewise, unsuitable habitat located outside of the threshold distance remains unsuitable: an original score of 9 is reclassified as 9.5. All pixels of habitat *within* the threshold distance of a critical feature maintain their original habitat score.

Identifying Potential Breeding Patches and Potential Population Cores

The habitat suitability map provides scores for each pixel. The analyst needs to identify – both in the Habitat Blocks and in the Potential linkage area – areas of good habitat large enough to support reproduction. Specifically, the analyst needs to identify

- *potential breeding patches*: areas large enough to support a breeding unit (individual female with young, or a breeding pair) for one breeding season. Such patches could be important stepping-stones for species that are unlikely to cross a potential linkage area within a single lifetime.

- *potential population cores*: areas large enough to support a breeding population of the focal species for about 10 years.

To do so, first calculate the suitability of any pixel as the average habitat suitability in a neighborhood of pixels surrounding it (Figure 4). Calculate average habitat suitability within a 3x3-pixel neighborhood (0.81 ha) for less-mobile species, and within a 200-m radius (12.6 ha) for more-mobile species[4]. Thus each pixel has both a *pixel score* and a *neighborhood score*. Then join adjacent pixels of suitable habitat (pixels with neighborhood score < 5) into polygons that represented potential breeding patches or potential population cores. The minimum sizes for each patch type are specified by the biologists who provided scores for the habitat suitability model.

4 An animal that moves over large areas for daily foraging perceives the landscape as composed of relatively large patches, because the animal readily moves through small swaths of unsuitable habitat in an otherwise favorable landscape (Vos et al. 2001). In contrast, a less-mobile mobile has a more patchy perception of its surroundings. Similarly, a small island of suitable habitat in an ocean of poor habitat will be of little use to an animal with large daily spatial requirements, but may be sufficient for the animal that requires little area.

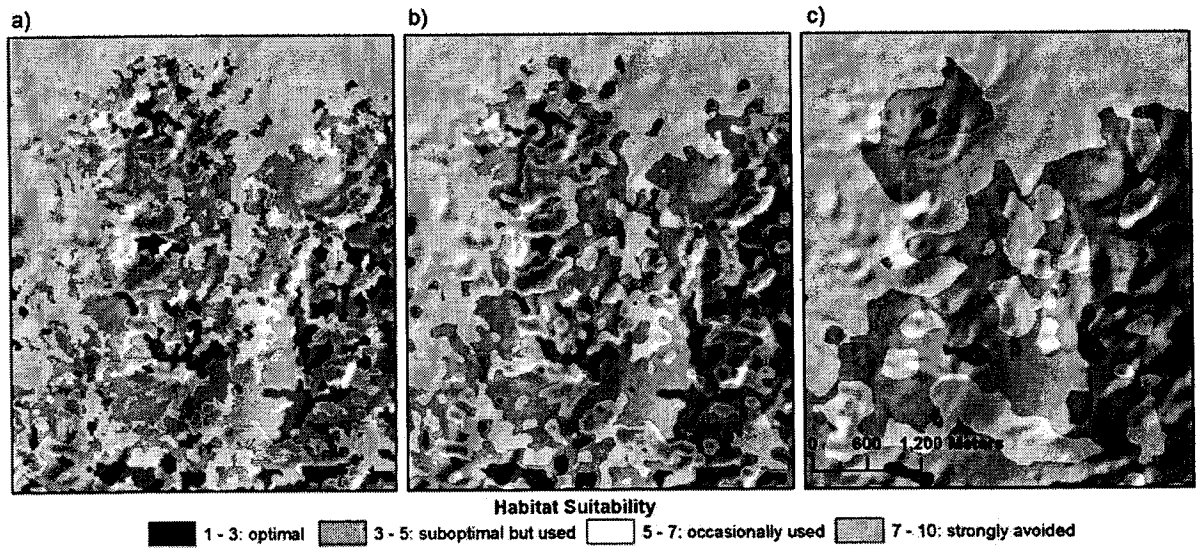


Figure 4: Example moving window analysis which calculates the average habitat suitability surrounding a pixel. a) original habitat suitability model, b) 3x3-pixel moving window, c) 200m radius moving window

Identifying Biologically Best Corridors

The *biologically best corridor*[5] (BBC) is a continuous swath of land that is predicted to be the best (highest permeability, lowest cost of travel) route for a species to travel from a potential population core in one protected habitat block to a potential population core in the other protected habitat block. *Travel cost* increases in areas where the focal species experiences poor nutrition or lack of suitable cover. *Permeability* is simply the opposite of travel cost, such that a perfectly permeable landscape would have a travel cost at or near zero.

Develop BBCs only for some focal species, namely species that (a) exist in both protected habitat blocks, or have historically existed in both and could be restored to them, (b) can move between protected blocks in less time than disturbances such as fire or climate change will make the current vegetation map obsolete, (c) move near the ground through the vegetation layer (rather than flying, swimming, or being carried by the wind), and (d) have habitat preferences that can reasonably be represented using GIS

5 This approach has often been called Least Cost Corridor Analysis (Beier et al. 2006) because it identifies areas that require the least cost of travel (energetic cost, risk of mortality) to the animal. However, the words "least cost" are easily misunderstood as referring to the dollar cost of conserving land or building an underpass.

variables. For focal species that did not meet these criteria, conduct patch configuration analysis (next section).

To define the start and end points for a corridor, identify potential population cores and habitat patches that fall completely within each protected habitat block. If potential population cores exist within each block, use these potential cores as the starting & ending points for the corridor analysis. Otherwise, the start-end points should be potential habitat patches within the protected habitat block or (for a wide-ranging species with no potential habit patch entirely within a habitat block) any suitable habitat within the protected block.

To create each biologically best corridor, use the habitat suitability score as an estimate of the cost of movement through the pixel6. Use these three rules to transform habitat suitability scores into travel costs, depending on ecological characteristics of the species:

- For a *locally widespread species* (habitat suitability score < 5 in nearly all of the potential linkage zone, suggesting that breeding populations could occur throughout), use the raw pixel habitat suitability score as the travel cost score.

Assign species not widespread throughout the potential linkage area into 1 of 2 groups:

- For *corridor-dwelling species* (species needing weeks to generations to traverse the potential linkage area – including most reptiles, amphibians, and small mammals)7, reassign a score of 1 to each pixel in a potential habitat patch or potential population core. The rationale is that these areas provide steppingstones for multi-generational movement. Do not rescore single pixels, or polygons smaller than a potential breeding area, because these are too small to provide meaningful stopover habitat.

- For *passage species* (mobile species that can make the journey between protected habitat blocks in a single movement event of a few hours or days), assign each pixel with a pixel habitat suitability score of 1 through 5 a travel cost score of 1. In models that lacked this rescoring, the biologically best corridor tended to follow an unrealistic straight line rather than best habitat.

For each pixel, calculate the lowest cumulative cost to that pixel from a starting point in one protected habitat block. Similarly calculate the lowest cumulative travel cost from the 2nd protected habitat block, and add these 2 travel costs to calculate the *total travel cost* for each pixel. The total travel cost thus reflects the lowest possible cost associated with a path between habitat blocks that passes through the pixel.

6 Levey et al. (2005) provide evidence that animals make movement decisions based on habitat suitability.
7 Beier & Loe (1992) introduced this distinction between *passage species* and *corridor-dwelling* species.

Finally, define the biologically best corridor as the swath of pixels with the lowest total travel cost and a minimum width of 500 m (Figure 5). If a species has two or more distinct strands in its biologically best corridor, eliminate any strand markedly worse than the best strand, but retain multiple strands if they have roughly equal travel cost and spacing among habitat patches.

After developing a biologically best corridor for each species, combine biologically best corridors to form a union of biologically best corridors (UBBC).

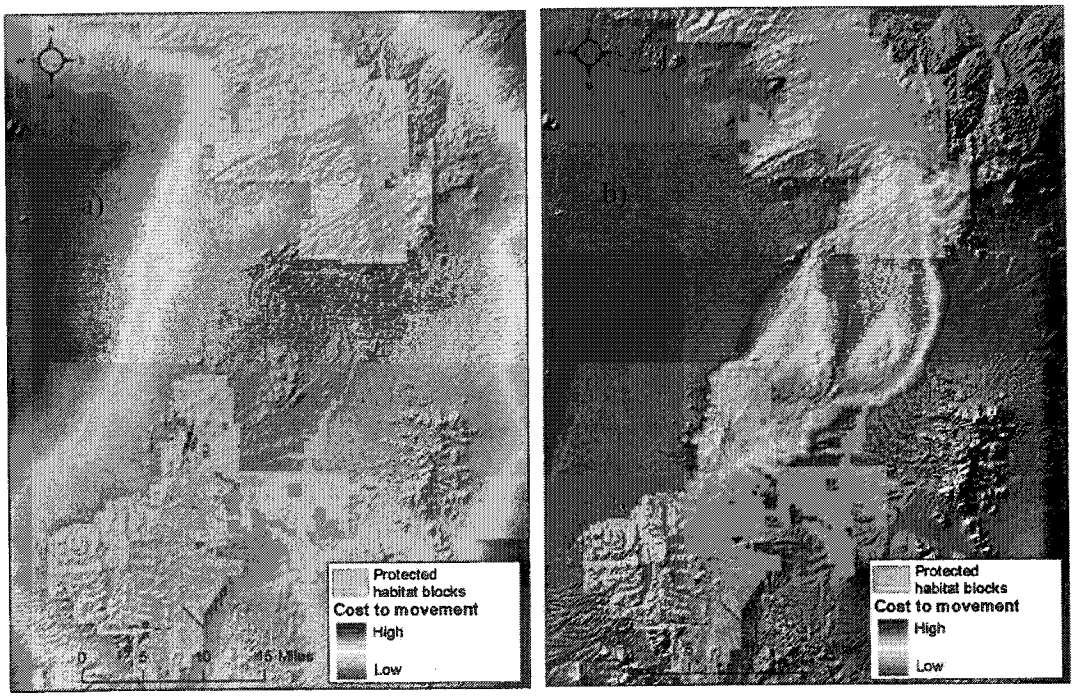


Figure 5: a) Landscape permeability layer for entire landscape, b) biologically best corridor composed of most permeable 10% of landscape.

Patch Configuration Analysis

Although the UBBC identifies an optimum corridor between the protected habitat blocks, this optimum might be poor for a species with little suitable habitat in the potential linkage area. Furthermore, corridor analyses were not conducted for some focal species (see 2nd paragraph of previous section). To address these issues, examine the maps of potential population cores and potential habitat patches for each focal species (including species for which a BBC was estimated) in relation to the UBBC. For each species, examine whether the UBBC encompasses adequate potential habitat patches and potential habitat cores, and compare the distance between neighboring habitat patches to the

dispersal[8] distance of the species. For those species (*corridor-dwellers*, above) that require multiple generations to move between protected habitat blocks, a patch of habitat beyond dispersal distance will not promote movement. For such species, look for potential habitat patches within the potential linkage area but outside of the UBBC. When such patches are within the species' dispersal distance from patches within the UBBC or a habitat block, add these polygons to the UBBC to create a *preliminary linkage design.*

Minimum Linkage Width

Wide linkages are beneficial for several reasons outlined above. To address these concerns, establish a minimum width of 1.5 km (0.94 mi) along the length of each terrestrial branch of the preliminary linkage design, except where existing urbanization precludes such widening. Widen bottlenecks first by adding natural habitats, and then by adding agricultural lands if no natural areas are available.

It is especially important that the linkage will be useful in the face of climate change. Climate change scientists unanimously agree that average temperatures will rise 2 to 6.4 C over pre-industrial levels by 2100, and that extreme climate events (droughts and storms) will become more common (Millennium Ecosystem Assessment 2005). Although it is less clear whether rainfall will increase or decrease in any location, there can be no doubt that the vegetation map in 2050 and 2100 will be significantly different than the map of current vegetation used in today's analyses. Implementing a corridor design narrowly conforming to current distribution of vegetation types would be risky. Therefore, in widening terrestrial linkage strands, attempt to maximize local diversity of aspect, slope, and elevation to provide a better chance that the linkage will have most vegetation types well-distributed along its length during the coming decades of climate change. Because of the diversity of focal species used to develop the UBBC, the preliminary linkage design will probably have great of topographic diversity, and minimal widening will be needed.

Expanding the linkage to this minimum width produces the final linkage design.

Field Investigations

Although these analyses consider human land use and roads, the GIS layers only crudely reflect important barriers that are only a pixel or two in width, such as freeways, canals, and major fences. Therefore visit each linkage design area to assess such barriers and identify restoration opportunities. Document areas of interest using GPS, photography, and field notes. Evaluate existing bridges, underpasses, overpasses, and culverts along highways as potential structures for animals to cross the highway, or as locations where improved crossing structures could be built. Note recent (unmapped) housing & residential developments, major fences and artificial night lighting that could impede

8 Dispersal distance is how far an animal moves from its birthplace to its adult home range. We used dispersal distances reported by the species expert, or in published literature. In some cases, we used dispersal distance for a closely-related species.

animal movement, and opportunities to restore native vegetation degraded by human disturbance or exotic plant species.

Helping Non-scientists Understand the Biological Value of Alternative Corridor Designs

The Linkage Design above provides a biological optimum. Various practical constraints will often require deviation from this biologically optimum design. During implementation of corridor designs, a diverse group of stakeholders must consider and compare alternative designs. Agencies making conservation investments prefer to buy large parcels from willing sellers, and developers will propose alternative corridor designs that do not affect their lands.

These alternative maps will differ from the biological optimum. How can decision-makers compare alternatives to the optimum, and know when to settle for "good enough"? The GIS analyst can calculate cost-distance for each alternative. But unfortunately, a 20% increase in cost-distance does not necessarily correspond to a 20% increase in animal mortality or a 20% decrease in gene flow. In other words, cost-distance is not a useful metric for comparison. Instead, we suggest histograms (e.g., of bottleneck lengths, bottleneck widths) and other metrics (e.g., average habitat suitability scores for each focal species, distances between suitable habitat patches within the linkage) to illustrate differences among alternative corridor designs. South Coast Wildlands and Arizona Wildlife Linkage Workgroup are currently developing such metrics and testing them on focal audiences.

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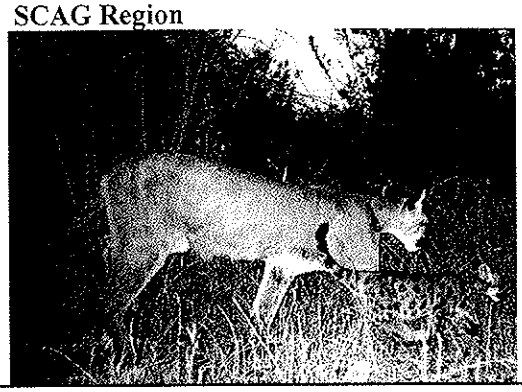
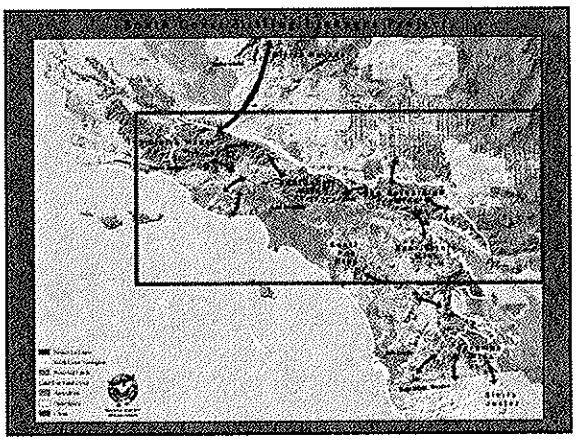
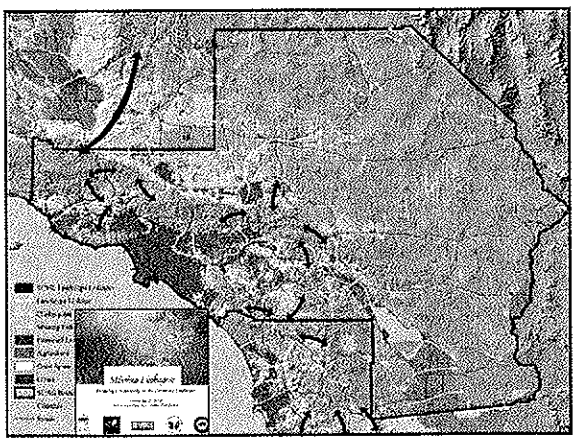
Conserving Wildlife Corridors in the SCAG Region





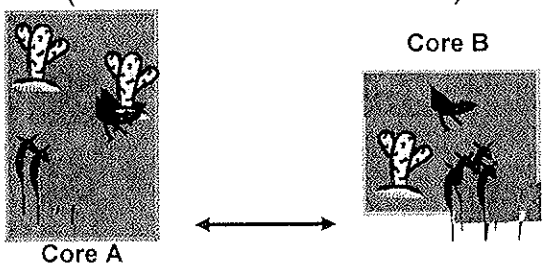


We will build on the science-based approach

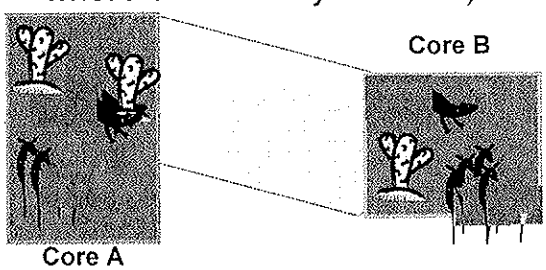
developed for 2 efforts

- Arizona Wildlife Linkage Workgroup
  24 linkage designs in Arizona, 2005-2008
- South Coast Missing Linkages
  15 linkage designs in S. California, 2001-2006

Start by defining the "rooms" (Corridors connect cores.)

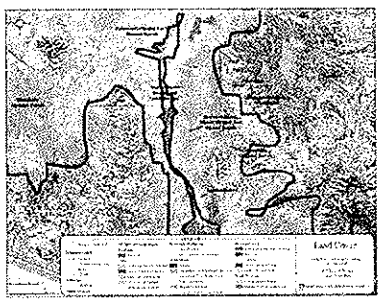


Identify Potential Linkages (areas where connectivity is at risk)



Foreground and background define each other

Cores, Potential Barriers, and Potential Linkages define each other



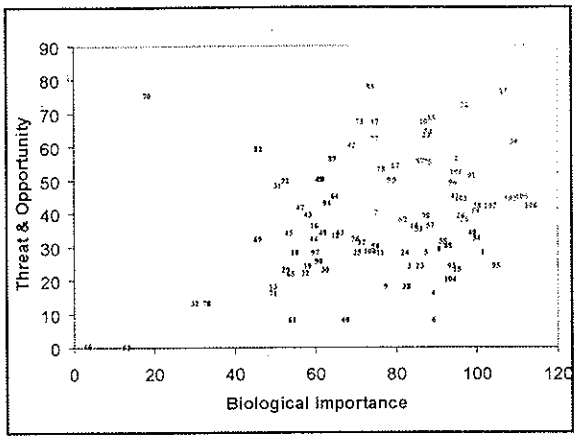
"Context not content"

We calculate Biological Value of each core as function of

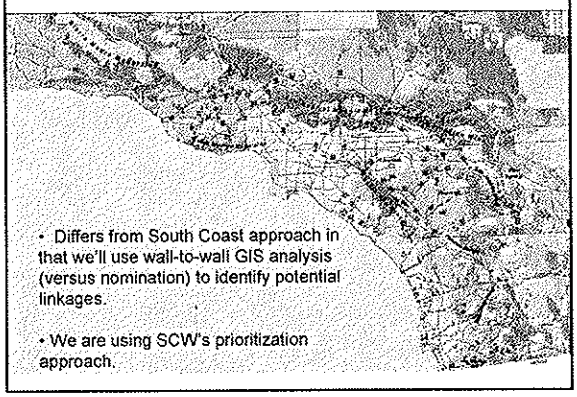
- Size
- Type
- Quality
- Uniqueness

We calculate Biological Value of each Potential Linkage as function of

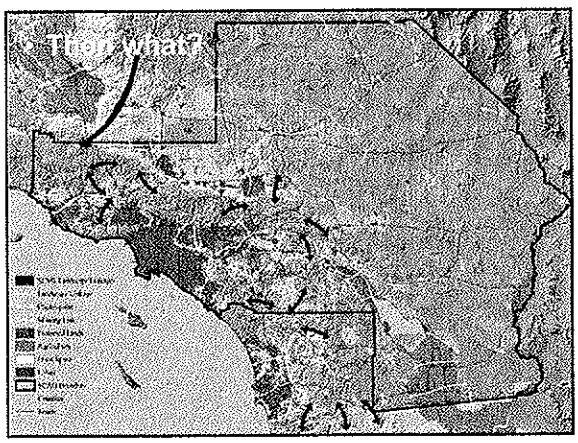
- the biological value of the 2 cores (!)
- the quality & uniqueness of the potential linkage itself are secondary factors.



18 Jan 2002 – Linkage Prioritization workshop

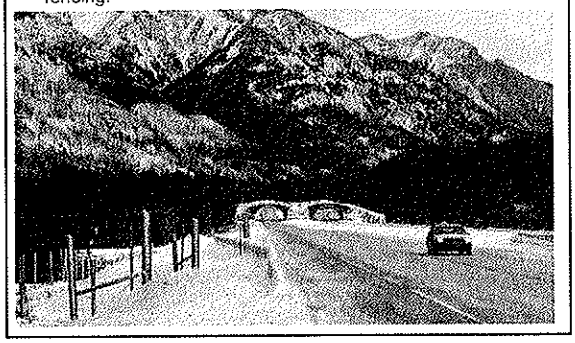


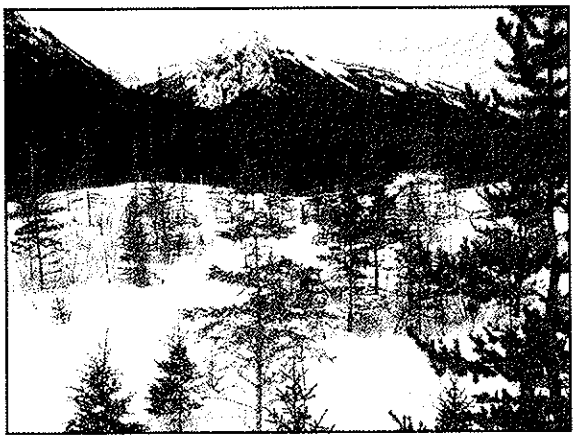
- Differs from South Coast approach in that we'll use wall-to-wall GIS analysis (versus nomination) to identify potential linkages.
- We are using SCW's prioritization approach.



Potential Linkages Across Roads

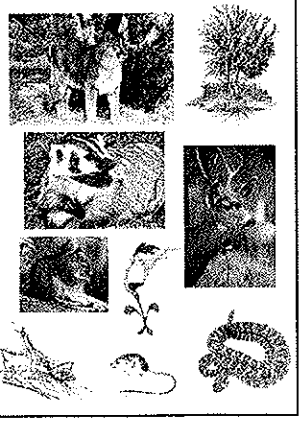
Best Management Practices: guidelines exist on frequency and type of crossing structures, integration with roadside fencing.





Potential Landscape Linkages (threats not just from a highway, but also from land conversion).

- For the high priority potential linkages, you will need to develop a linkage design based on needs of focal species



Developing Linkage Designs for High Priority Potential Linkages

You want to make sure your limited resources turn a *Potential* Linkage into a *Real, Conserved* Linkage!

And we'll make it possible to produce Linkage Designs yourself in house...

Making it easy to develop Linkage Designs: I

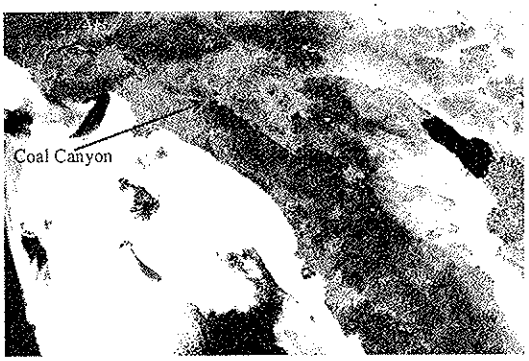
South Coast Wildlands has published fully-parameterized models for 109 focal species: Mammals, Amphibians, Reptiles, Fish, Birds, Invertebrates, & Plants

Making it easy to develop Linkage Designs: II

gisCORRIDOR

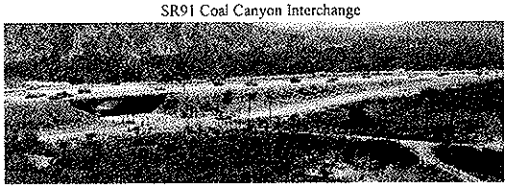
- My lab at NAU will offer this package of tools starting spring 2007
- Software and tutorials will be free.
- *Optional* ½-day training at low cost.
- Plus: EVALUATION tools to compare compromise designs to the biological optimum. These *new* tools will be crucial for implementation.

v



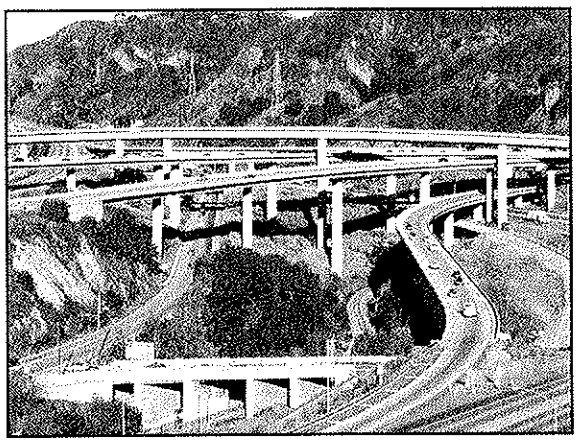
Restoring Connectivity Between Protected Areas

SR91 Coal Canyon Interchange



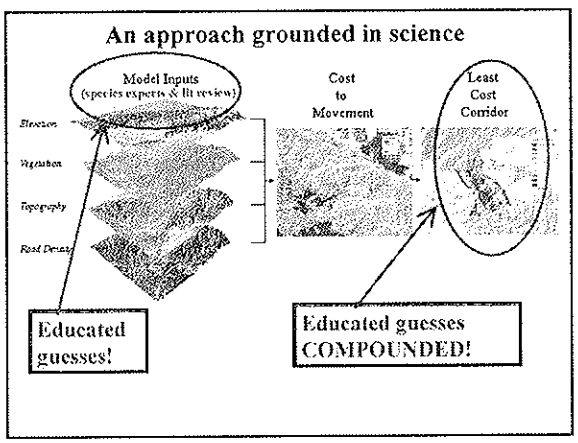
Asphalt-breaking ceremony: 10 Dec 2002

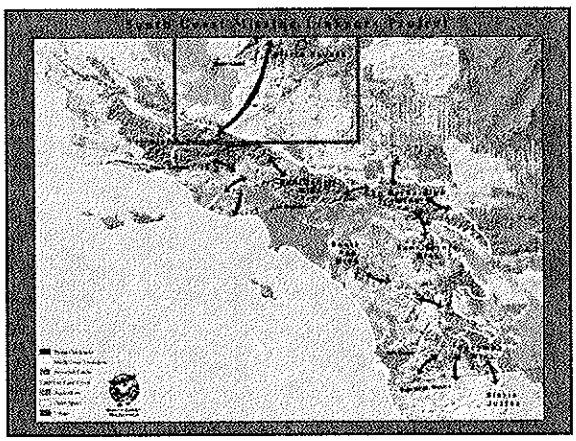
2006: $1.5-million project to recreate a natural, meandering delta for Coal Canyon Creek



Sensitivity Analysis of our Approach

Supplemental Slides

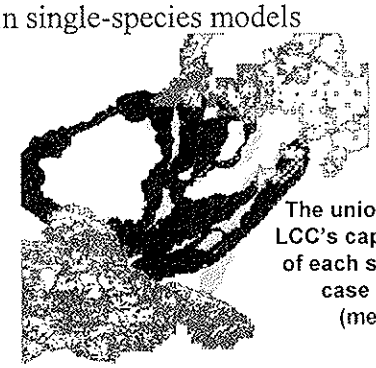




Sensitivity Analysis for 8 focal species.

1. Is the Linkage Design for an individual species stable when input parameters vary? (A: Yes for 5 species, No for 3 species.)
2. Even if individual LCC's are unreliable, is the Union of LCCs stable to uncertainty in input parameters? (A: Yes!)

Using multiple species mitigates errors in single-species models



The union of predicted LCC's captured 70-100% of each species' worst-case alternative (mean: 84%)

MEMO

DATE: September 12, 2006

TO: Open Space Working Group

FROM: Jessica Kirchner, Associate Regional Planner, (213) 236-1983, kirchner@scag.ca.gov

SUBJECT: 2004 RTP EIR Mitigation Measure Review

BACKGROUND:
The Southern California Association of Governments (SCAG) is the Metropolitan Planning Agency for the six-county region comprised of Los Angeles, Orange, San Bernardino, Riverside, Ventura and Imperial Counties. As such, SCAG prepares a long-range Regional Transportation Plan (RTP) every three (now four) years. The RTP provides long-range (20 years) transportation planning for the region. An Environmental Impact Report (EIR) is prepared for each RTP. The last RTP and EIR were published in 2004. The next RTP EIR will be published in 2007 and will include the results of this outreach effort.

SAFETEA-LU (Safe Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users) requires expanded coordination on the topic of mitigation for the RTP. SCAG is currently examining potential deficiencies between what is included in the 2004 RTP and what is required under SAFETEA-LU. Expanded coordination undertaken by SCAG will be documented and submitted to the federal agencies, along with additional efforts on topics such as safety and security. The federal agencies will then determine if SCAG's 2004 RTP meets the new federal requirements.

SUMMARY:
The RTP EIR is a programmatic document that addresses anticipated growth in the region through 2030 and the impacts of this development at a regional scale; it also identifies programmatic mitigation for this development. As a programmatic document, the RTP EIR is intended to serve as a "first tier" of environmental review for specific projects in the region. Lead Agencies for specific projects (both planning projects and actual development projects), may use the RTP EIR to address regional scale impacts and mitigation of those impacts.

SCAG is interested in making the RTP mitigation measures as useful as possible for subsequent use in for specific projects (Tier 2 environmental documents). SCAG hopes to gain input on the following:

- How could the current mitigation measures included in the 2004 RTP EIR (attached) be written to be of more assistance when writing Tier 2 documents?
- Are there additional measures/performance standards that could reduce the number/volume of Tier 2 documents?
- Are there technical details and/or more specific performance standards for trustee and resource agencies that could be reasonably used to help identify and protect important regional resources?

Today, staff is soliciting comments from the Open Space Working Group members on the 2004 RTP EIR mitigation measures.

In addition, SCAG is contacting all the cities and counties in the region as well as federal, state and local land planning/resource, wildlife, historic, transportation and tribal agencies to specifically follow up on the mitigation measures included in the 2004 RTP EIR. To gain input from the interested parties, SCAG will be conducting two regional workshops. These workshops will focus on the 2004 RTP EIR mitigation measures and will be held at the following locations and times:

MEMO

Tuesday, October 10th, 11 am - Noon
Southern California Association of Governments
818 W. 7th Street, 12th Floor
Los Angeles, CA 90017

Thursday, October 12th, 1:30 p.m. – 2:30 p.m.
Southern California Association of Governments – Riverside Office
3600 Lime Street, Suite 216
Riverside, CA 92501

ATTACHMENT:
2004 RTP PEIR Mitigation Measures

MITIGATION MEASURES
SCAG 2004 RTP EIR

Fundamentally, mitigation measures must be within the Lead Agency's jurisdiction to impose and enforce in order for the measure to be considered "feasible". See CEQA §21081.6 (b)&(c) and 2005 State CEQA Guidelines §15041(b) and §15126.4(2)]. I have identified a number of the original mitigation measures that may be beyond SCAG's jurisdictional/statutorial responsibilities to impose and/or enforce. These measures are specifically identified in the following pages.

The Mitigation Measures contained in the 2004 RTP EIR rely on a variety of terms when referring to local *Lead Agencies* or others who will be implementing specific projects contained in the RTP. Some of the terms used include:

- project implementation agencies;
- implementing agency;
- member agencies;
- member cities and counties; and,
- lead agency.

---- MITIGATION MEASURES ----

Land Use

MM 3.1-1a: Individual projects must be consistent with Federal, State, and local policies that preserve agricultural lands and support the economic viability of agricultural activities, as well as policies that provide compensation for property owners if preservation is not feasible.

MM 3.1-1b: For projects impacting agricultural land, project implementation agencies shall contact the California Department of Conservation and each county's Agricultural Commissioner's office to identify the location of prime farmlands and lands that support crops considered valuable to the local or regional economy. Impacts to such lands shall be evaluated in project-specific environmental documents. The analysis shall use the land evaluation and site assessment (LESA) analysis method (CEQA Guidelines §21095), as appropriate. Mitigation measures may include conservation easements or the payment of in-lieu fees.

MM 3.1-1c: Project implementation agencies shall consider corridor realignment, buffer zones and setbacks, and berms and fencing where feasible, to avoid agricultural lands and to reduce conflicts between transportation uses and agricultural lands.

MM 3.1-1d: Prior to final approval of each project and when feasible and prudent, the implementing agency shall establish conservation easement programs to mitigate impacts to prime farmland.

MM 3.1-1e: Prior to final approval of each project, the implementing agency shall to the extent practical and feasible, avoid impacts to prime farmlands or farmlands that support crops considered valuable to the local or regional economy.

MM 3.1-1f: Prior to final approval of each project, the implementing agency shall encourage enrollments of agricultural lands for counties that have Williamson Act programs, where applicable.

MM 3.1-1g: SCAG shall encourage implementation agencies to establish transfer of development rights (TDR) programs to direct growth to less agriculturally valuable lands (while considering the potential effects at the sites receiving the transfer) and ensure the continued protection of the most agriculturally valuable land within each county through the purchase of the development rights for these lands.

MM 3.1-1h: SCAG shall encourage implementation agencies to avoid the premature conversion of farmlands by promoting infill development and the continuation of agricultural uses until urban development is imminent; if development of agricultural lands is necessary, growth should be directed to those lands on which the continued viability of agricultural production has been compromised by surrounding urban development or the loss of local markets.

MM 3.1-1i: SCAG shall encourage implementation agencies to obtain assistance from the American Farmland Trust in developing and implementing farmland conservation measures.

MM 3.1-2a: Project implementation agencies shall ensure that projects are consistent with Federal, State, and local plans that preserve open space.

MM 3.1-2b: Project implementation agencies shall consider corridor realignment, buffer zones and setbacks, and berms and fencing where feasible, to avoid open space and recreation land and to reduce conflicts between transportation uses and open space and recreation lands.

MM 3.1-2c: Project implementation agencies shall identify open space areas that could be preserved and shall include mitigation measures (such as dedication or payment of in-lieu fees) for the loss of open space.

MM 3.1-2d: Prior to final approval of each project, the implementing agency shall conduct the appropriate project-specific environmental review, including consideration of loss of open space. Potential significant impacts to open space shall be mitigated, as feasible. The project implementation agencies or local jurisdiction shall be responsible for ensuring adherence to the mitigation measures prior to construction.

MM 3.1-2e: For projects that require approval or funding by the U.S. Department of Transportation, project implementation agencies shall comply with Section 4(f) of the U.S. Department of Transportation Act.

MM 3.1-2f: Future impacts to open space and recreation lands shall be avoided through cooperation, information sharing, and program development during the update of the Open Space and Conservation chapter of SCAG's Regional Comprehensive Plan and Guide and through SCAG's Energy and Environment Committee.

MM 3.1-2g: SCAG shall encourage member jurisdictions to work as partners to address regional outdoor recreation needs and to acquire the necessary funding for the implementation of their plans and programs.

MM 3.1-2h: SCAG shall encourage member jurisdictions that have trails and trail segments determined to be regionally significant to work together to support regional trail networks. SCAG shall encourage joint use of utility, transportation and other rights-of-way, greenbelts, and biodiversity areas.

MM 3.1-2i: To provide more opportunities for access to open space close to the urban core, SCAG shall encourage that multiple use of spaces be allowed as feasible and practical and encourage redevelopment activities to focus some investment on recreation uses.

MM 3.1-3a: SCAG shall encourage through regional policy comments that cities and counties in the region provide SCAG with electronic versions of their most recent general plan and any updates as they are produced.

MM 3.1-3b: SCAG shall encourage through regional policy comments that cities and counties update their general plans at least every ten years, as recommended by the Governor's Office of Planning and Research.

MM 3.1-3c: SCAG shall work with its member cities and counties to help ensure that transportation projects and growth are consistent with the RTP and general plans.
MM 3.1-3d: Planning is an iterative process and SCAG is a consensus building organization. SCAG shall work with cities and counties to ensure that general plans reflect RTP policies. SCAG will work to build consensus on how to address inconsistencies between general plans and RTP policies.

MM 3.1-4a: SCAG's Growth Visioning program and the forthcoming Regional Growth Vision will be used to build a consensus in the region to support changes in land use to accommodate future population growth while maintaining the quality of life in the region.

Population, Housing and Employment
MM 3.2-1a: SCAG shall work with its member agencies to implement growth strategies to create an urban form designed to utilize the existing transportation networks and the transportation improvements contained in the 2004 RTP, enhancing mobility and reducing land consumption.

MM 3.2-2a: For projects with the potential to displace homes and/or businesses, project implementation agencies shall evaluate alternate route alignments and transportation facilities that minimize the displacement of homes and businesses. An iterative design and impact analysis would help where impacts to homes or businesses are involved. Potential impacts shall be minimized to the extent feasible. If possible, existing rights-of-way should be used.

MM 3.2-2b: Project implementation agencies shall identify businesses and residences to be displaced. As required by law, relocation assistance shall be provided to displaced residents and businesses, in accordance with the federal Uniform Relocation and Real Property Acquisition Policies Act of 1970 and the State of California Relocation Assistance Act, as well as any applicable City, County, and Port policies.

MM 3.2-2c: Project implementation agencies shall develop a construction schedule that minimizes potential neighborhood deterioration from protracted waiting periods between right-of-way acquisition and construction.

MM 3.2-3a: Project implementation agencies shall design new transportation facilities that consider access to existing community facilities, as feasible. During the design phase of the project, community amenities and facilities shall be identified and considered in the design of the project.

MM 3.2-3b: Project implementation agencies shall design roadway improvements that minimize barriers to pedestrians and bicyclists, as feasible. During the design phase, pedestrian and bicycle routes shall be determined that permit connections to nearby community facilities.

MM 3.2-4a: SCAG's Growth Visioning program and the forthcoming Regional Growth Vision shall be used to work toward building a consensus in the region to support changes in land use to accommodate future population growth while maintaining the quality of life in the region.

Transportation

MM 3.3-1b: SCAG shall encourage education about and implementation of California's Parking Cash Out law as a means of further reducing VMT.

MM 3.3-3a: SCAG shall encourage the ports to extend their operating hours in order to reduce heavy-duty truck traffic during peak periods, thereby reducing the VHT these trucks spend in delay.

Air Quality

MM 3.4-1a: Additional mitigation measures are hereby incorporated by reference from the following air quality management plans:
- 2003 SCAQMP/State Implementation Plan (SIP)

- Ventura County Air Quality Management Plan (2004 AQMP – Limited SIP Updated, Scheduled for adoption in March 2004)
- Mojave Desert Air Quality Management Plan (1996)
- Antelope Valley Air Quality Management Plan (1994/97)
- Imperial County Air Quality Management Plan (1991 and 1993)
-

MM 3.4-1b: The 2003 SCAQMP control measures consist of 1) SCAQMD's Stationary and Mobile Source Control Measures; 2) State and Federal Source Control Measures proposed by CARB; and 3) Transportation Strategy and Control measures provided by SCAG. These control measures are based on the implementation of short-term, defined measures as well as long-term measures, which will rely on new technologies to further reduce emissions. The SCAQMP includes estimated emissions reductions based on these short-term and long-term programs. The transportation improvements proposed for the short-term emissions reductions are grouped in the SCAQMP under Transportation Control Measure (TCM) project categories and include the following measures:

- High Occupancy Vehicle (HOV) Measures: New HOV lanes, HOV bypasses and connectors, interchanges, High Occupancy Toll (HOT) Lanes;
- Transit and System Management Measures: Transit, Intermodal Transfer Facilities, Non-motorized Transportation Mode Facilities
- Information-based Transportation Strategies: Marketing for Rideshare and other services, Intelligent Transportation Systems, Telecommuting Programs and Real-time rail, transit or freeway information systems.

The 2004 RTP has been prepared to facilitate implementation of the transportation control measures outlined in the 2003 SCAQMP. The 2004 RTP incorporates both the capital and non-capital improvements recommended by the SCAQMP.

Air Resources Board's (ARB) strategy, outlined in the South Coast SIP, includes the following elements:

- Set technology forcing new engine standards;
- Reduce emissions from the in-use fleet;
- Require clean fuels, and reduce petroleum dependency;
- Work with U.S. EPA to reduce emissions from federal and state sources; and
- Pursue long-term advanced technologies measures.

MM 3.4-3a: Apply water or dust suppressants to exposed earth surfaces to control emissions.

MM 3.4-3b: All excavating and grading activities shall cease during second stage smog alerts and periods of high winds.

MM 3.4-3c: All trucks hauling dirt, sand, soil, or other loose materials off-site shall be covered or wetted or shall maintain at least two feet of freeboard (i.e., minimum vertical distance between the top of the load and the top of the trailer).

MM 3.4-3d: All construction roads that have high traffic volumes, shall be surfaced with base material or decomposed granite, or shall be paved or otherwise be stabilized.

MM 3.4-3e: Public streets shall be cleaned, swept or scraped at frequent intervals or at least three times a week if visible soil material has been carried onto adjacent public roads.

MM 3.4-3f: Construction equipment shall be visually inspected prior to leaving the site and loose dirt shall be washed off with wheel washers as necessary.

MM 3.4-3g: Water or non-toxic soil stabilizers shall be applied as needed to reduce off-site transport of fugitive dust from all unpaved staging areas and other unpaved surfaces.

MM 3.4-3h: Traffic speeds on all unpaved construction surfaces shall not exceed 15 mph.
MM 3.4-3i: Low sulfur or other alternative fuels shall be used in construction equipment where feasible.

MM 3.4-3j: Deliveries related to construction activities that affect traffic flow shall be scheduled during off-peak hours (e.g. 10:00 A.M. and 3:00 P.M.) and coordinated to achieve consolidated truck trips. When the movement of construction materials and/or equipment impacts traffic flow, temporary traffic control shall be provided to improve traffic flow (e.g., flag person).

MM 3.4-3k: To the extent possible, construction activity shall utilize electricity from the power grid rather than temporary diesel power generators and/or gasoline power generators.

MM 3.4-3l: Revegetate exposed earth surfaces following construction.

MM 3.4-3m: Encourage the incorporation of specific incentives into the contract bidding process to promote the use of clean fuel or low-emission construction equipment.

MM 3.4-3n: Require the use of Diesel Particulate Traps, where feasible and appropriate.

MM 3.4-3o: Require restrictions on truck and construction equipment idling for equipment of all fuel types.

MM 3.4-3p: Encourage the restriction of operations to alternative fuel vehicles, where feasible and appropriate.

MM 3.4-3q: Incentivize ride sharing and mass transit among construction workers to the extent possible. *(Likely infeasible as a practical matter)*

MM 3.4-3r: Water any exposed surfaces at least twice daily to maintain surface crust, where appropriate.

MM 3.4-4a: Construction equipment shall be equipped with diesel particulate traps. Low sulfur or other alternative fuels shall be used in construction equipment where feasible.

Noise

MM 3.5-1a: Project implementing agencies shall comply with all local sound control and noise level rules, regulations, and ordinances.

MM 3.5-1b: In residential areas, project implementing agencies shall limit the hours of construction to between 6:00 a.m. and 8:00 p.m. on Monday through Friday and between 7:00 a.m. and 8:00 p.m. on weekends.

MM 3.5-1c: Equipment and trucks used for project construction shall utilize the best available noise control techniques (including mufflers, use of intake silencers, ducts, engine enclosures and acoustically attenuating shields or shrouds) in order to minimize construction noise impacts.

MM 3.5-1d: Impact equipment (e.g., jack hammers, pavement breakers, and rock drills) used for project construction will be hydraulically or electrically-powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatically powered tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves shall be used where feasible, and this could achieve a reduction of 5dBA. Quieter procedures shall be used (such as drilling rather than impact equipment) whenever feasible.

MM 3.5-1e: Project implementing agencies shall ensure that stationary noise sources shall be located as far from sensitive receptors as possible. If they must be located near existing receptors, they shall be adequately muffled.

MM 3.5-1f: The project implementing agencies shall designate a complaint coordinator responsible for responding to noise complaints received during the construction phase. The name and phone number of the complaint coordinator shall be conspicuously posted at construction areas and on all advance notifications. This person will be responsible for taking steps required to resolve complaints, including periodic noise monitoring, if necessary.

MM 3.5-1g: Noise generated from any rock-crushing or screening operations performed within 3,000 feet of any occupied residence shall be mitigated by the project proponent by strategic placement of material stockpiles between the operation and the affected dwelling or by other means approved by the local jurisdiction.

MM 3.5-1h: Project implementing agencies shall direct contractors to implement appropriate additional noise mitigation measures including, but not limited to, changing the location of stationary construction equipment, shutting off idling equipment, rescheduling construction activity, notifying adjacent residents in advance of construction

work, and installing acoustic barriers around stationary construction noise sources to comply with local noise control requirements.

MM 3.5-1i: Project implementing agencies shall use portable barriers during construction of subsurface barriers, debris basins, and storm water drainage facilities.

MM 3.5-1j: In residential areas, pile driving will be limited to daytime working hours. No pile driving or blasting operations shall be performed within 3,000 feet of an occupied residence on Sundays, legal holidays, or between the hours of 8:00 p.m. and 8:00 a.m. on other days. Any variance from this condition shall be obtained from the project proponent and must be approved by the local jurisdiction.

MM 3.5-1k: Wherever possible, sonic or vibratory pile drivers will be used instead of impact pile drivers (sonic pile drivers are only effective in some soils). If sonic or vibratory pile drivers are not feasible, acoustical enclosures shall be provided as necessary to ensure that pile-driving noise does not exceed speech interference criterion at the closest sensitive receptor.

MM 3.5-1l: Engine and pneumatic exhaust controls on pile drivers will be required as necessary to ensure that exhaust noise from pile driver engines is minimized to the extent feasible.

MM 3.5-1m: Where feasible, pile holes shall be pre-drilled to reduce potential noise and vibration impacts.

MM 3.5-2a: As part of the appropriate environmental review of each project, a project-specific noise evaluation shall be conducted and appropriate mitigation identified and implemented.

MM 3.5-2b: Project implementation agencies shall employ, where their jurisdictional authority permits, land use planning measures, such as zoning, restrictions on development, site design, and use of buffers to ensure that future development is compatible with adjacent transportation facilities.

MM 3.5-2c: Project implementation agencies shall, to the extent feasible and practicable, maximize the distance between noise-sensitive land uses and new roadway lanes, roadways, rail lines, transit centers, park-and-ride lots, and other new noise-generating facilities.

MM 3.5-2d: Project implementing agencies shall construct sound-reducing barriers between noise sources and noise-sensitive land uses. Sound barriers can be in the form of earth-berms or soundwalls. Constructing roadways so that they are depressed below-grade of the existing sensitive land uses also creates an effective barrier between the roadway and sensitive receptors.

MM 3.5-2e: Project implementing agencies shall, to the extent feasible and practicable, improve the acoustical insulation of dwelling units where setbacks and sound barriers do not sufficiently reduce noise.

MM 3.5-2f: The project implementing agencies shall implement, to the extent feasible and practicable, speed limits and limits on hours of operation of rail and transit systems.

MM 3.5-2g: To reduce noise impacts, maximize distance of the Maglev route alignment from sensitive receptors. If the Maglev guideway were constructed along the center of a freeway, operation noise impacts would be reduced by the increase in distance to the noise sensitive sites and the masking effects of the freeway traffic noise.

MM 3.5-2h: Reduce Maglev speed in the vicinity of sensitive receptors.

MM 3.5-2i: As a last resort, eliminate the noise-sensitive receptor by acquiring rail and freeway right-of-way. This would ensure the effective operation of all transportation modes.

MM 3.5-2j: Passenger stations, maintenance facilities, decentralized maintenance facilities and electric substations should be located away from sensitive receptors, unless this mitigation would impede implementation of architecturally acceptable Transit Oriented Development (TOD) and appropriate infill development.

MM 3.5-4a: SCAG shall encourage airport sponsors to implement voluntary curfews, changes in aircraft operations, adjacent land use compatibility, and physical noise buffers for aircraft and vehicles, where appropriate and feasible, to minimize noise impacts of aviation activities.

Aesthetics and Views

MM 3.6-1a: Project implementation agencies shall implement design guidelines, local policies, and programs aimed at protecting views of scenic corridors and avoiding visual intrusions.

MM 3.6-1b: Project implementation agencies shall, to the extent feasible, construct noise barriers of materials whose color and texture complements the surrounding landscape and development. Noise barriers shall be graffiti resistant and landscaped with plants that screen the barrier, preferably with either native vegetation or landscaping that complements the dominant landscaping of surrounding areas.

MM 3.6-2a: Project implementation agencies shall, where practicable and feasible, avoid construction of transportation facilities in state and locally designated scenic highways and/or vista points.

MM 3.6-2b: Project implementation agencies shall complete design studies for projects in designated or eligible Scenic Highway corridors and develop site-specific mitigation

measures to minimize impacts on the quality of the views or visual experience that originally qualified the highway for Scenic designation.

MM 3.6-2c: If transportation facilities are constructed in state and locally designated scenic highways and/or vista points, design, construction, and operation of the transportation facility shall be consistent with applicable guidelines and regulations for the preservation of scenic resources along the designated scenic highway.

MM 3.6-3a: Project implementation agencies develop design guidelines for each type of transportation facility that make elements of proposed facilities visually compatible with surrounding areas. Visual design guidelines shall, at a minimum, include setback buffers, landscaping, color, texture, signage, and lighting criteria. The following methods shall be employed whenever possible:

- □ Transportation systems shall be developed to be compatible with the surrounding environment (i.e., colors and materials of construction material).
- □ If exotic vegetation is used, it shall be used as screening and landscaping that blends in and complements the natural landscape.
- □ Trees bordering highways shall remain or be replaced so that clear-cutting is not evident.
- □ Grading shfeasible all blend with the adjacent landforms and topography.

MM 3.6-4a: Project implementation agencies shall design projects to minimize contrasts in scale and massing between the project and surrounding natural forms and development. Project implementation agencies shall design projects to minimize their intrusion into important view sheds and use contour grading to better match surrounding terrain.

MM 3.6-4b: Project implementation agencies shall use natural landscaping to minimize contrasts between the project and surrounding areas. Wherever possible, develop interchanges and transit lines at the grade of the surrounding land to limit view blockage. Contour the edges of major cut and fill slopes to provide a more natural looking finished profile.

MM 3.6-5a: In visually sensitive site areas, local land use agencies shall apply development standards and guidelines to maintain compatibility with surrounding natural areas, including site coverage, building height and massing, building materials and color, landscaping, site grading, etc.

Biological Resources

MM 3.7-1.a: Each transportation project shall assess displacement of habitat due to removal of native vegetation during route planning.Routes shall be planned in order to avoid and/or minimize removal of native vegetation.

MM 3.7-1.b: When avoidance of native vegetation removal is not possible, each transportation project shall replant disturbed areas with commensurate native vegetation of high habitat value adjacent to the project (i.e. as opposed to ornamental vegetation with relatively less habitat value), as appropriate based on the site conditions, and other considerations of the lead agency and appropriate resource agencies.jurisdiction

MM 3.7-1c: Individual transportation projects shall include offsite habitat enhancement or restoration to compensate for unavoidable habitat losses from the project site as appropriate based on the site conditions, and other considerations of the lead agency and appropriate resource agencies.

MM 3.7-2a: Individual transportation projects included in the 2004 RTP shall conduct site-specific analyses of opportunities to preserve or improve habitat linkages with areas on and off-site. Mitigation banking (opportunities to purchase, maintain, and/or restore offsite habitat) is one opportunity that project proponents and jurisdictions may pursue.

MM 3.7-2b: Each transportation project, including expansion and retrofitting of existing transportation structures, shall provide or rehabilitate wildlife crossings/access at locations useful and appropriate for the species of concern, as feasible and appropriate.

MM 3.7-2c: Individual transportation projects shall include analysis of wildlife corridors during project planning. These studies shall be conducted by qualified biologists with the appropriate expertise, as determined by the lead agency, and they shall be conducted using appropriate methodology over an appropriate time period, especially to account for species with large territories, seasonal variation in movement patterns, and rare or uncommon species. Impacts to these corridors shall be avoided and/or minimized and monitoring of wildlife movement and the success of constructed corridors such as undercrossings should continue for at least one year after construction.

MM 3.7-2d: Each transportation project included in the Plan shall use wildlife fencing where appropriate to minimize the probability of wildlife injury due to direct interaction between wildlife and roads. Inclusion of this mitigation measure shall be considered on a case-by-case basis, as use of wildlife fencing could further increase the effects of habitat fragmentation and isolation for many species.

MM 3.7-3a: Individual transportation projects shall minimize vehicular accessibility to areas beyond the actual transportation surface. This can be accomplished through fencing and signage.

MM 3.7-3b: Each project shall establish litter control programs in appropriate areas, such as trash receptacles at road turnouts and viewpoints.

MM 3.7-3c: Each project shall use road noise minimization methods, such as brush and tree planting, at heavy noise-producing transportation areas that might affect wildlife. Native vegetation should be used.

MM 3.7-4a: Each project shall be preceded by pre-construction monitoring to ensure no sensitive species' habitat would be unnecessarily destroyed. All discovered sensitive species habitat shall be avoided where feasible, or disturbance shall be minimized.

MM 3.7-4b: Each project shall schedule work to avoid critical life stages (e.g. nesting) of species of concern.

MM 3.7-4c: Each project shall fence and/or mark sensitive habitat to prevent unnecessary machinery or foot traffic during construction activities.

MM 3.7-4d: When removal and/or damage to sensitive species habitat is unavoidable during construction, each project shall replant any disturbed natural areas with appropriate native vegetation following the completion of construction activities.

MM 3.7-5a: Individual projects shall avoid and/or minimize construction activities that have the potential to expose species to noise, smoke, or other disturbances. Pre-construction surveys shall be conducted as appropriate to determine the presence of any species that would need to be protected from such an impact.

MM 3.7-5b: Individual projects shall be scheduled to avoid construction during critical life stages or sensitive seasons (e.g. the nesting season).
MM 3.7-6a: Construction through or adjacent to wetlands or riparian areas shall be avoided where feasible through route planning.

MM 3.7-6b: Each transportation project shall avoid removal of wetland or riparian vegetation. Specific vegetation that is not to be removed would be so marked during construction. Riparian vegetation removal shall be minimized.

MM 3.7-6c: Each transportation project shall replace any disturbed wetland, riparian or aquatic habitat, either on-site or at a suitable off-site location at ratios to ensure no net loss.

MM 3.7-6d: When individual projects include unavoidable losses of riparian or aquatic habitat, adjacent or nearby riparian or aquatic habitat shall be enhanced (e.g. through removal of non-native invasive wetland species and replacement with more ecologically valuable native species) as appropriate based on the site conditions, and other considerations of the lead agency and appropriate resource agencies.

MM 3.7-7a: Individual projects near water resources shall implement Best Management Practices (BMPs) at construction sites to minimize erosion and sediment transport from the area. BMPs include encouraging growth of vegetation in disturbed areas, using straw bales or other silt-catching devices, and using settling basins to minimize soil transport. A more detailed description of BMPs is provided in Section 3.12 Water Resources.

MM 3.7-7b: Individual projects shall schedule construction activities to avoid sensitive times for biological resources (e.g. steelhead spawning periods during the winter and spring) and to avoid the rainy season when erosion and sediment transport is increased.

MM 3.7-9a: Future impacts to biological resources shall be minimized through cooperation, information sharing, and program development during the update of the Open Space and Conservation chapter of SCAG's Regional Comprehensive Plan and Guide and through SCAG's Energy and Environment Committee. SCAG shall consult with the resource agencies, such as U.S. Fish and Wildlife Service and California Department of Fish and Game shall be consulted during this update process.

Cultural Resources

MM 3.8-1a: As part of the appropriate environmental review of individual projects, project implementation agencies shall identify potential impacts to historic resources. A record search at the appropriate Information Center shall be conducted to determine whether the project area has been previously surveyed and whether resources were identified. Preservation

MM 3.8-1b: As necessary, prior to construction activities, project implementation agencies shall obtain a qualified architectural historian to conduct historic architectural surveys as recommended by the Archaeological Information Center. In the event the records indicate that no previous survey has been conducted, the Information Center will make a recommendation on whether a survey is warranted based on the sensitivity of the project area for cultural resources within 1,000 feet of the improvement.

MM 3.8-1c: Project implementation agencies shall comply with Section 106 of the National Historic Preservation Act if federal funding or approval is required. This law requires federal agencies to evaluate the impact of their actions on resources included in or eligible for listing in the National Register of Historic Places. Federal agencies must coordinate with the State Historic Preservation Officer in evaluating impacts and developing mitigation. These mitigation measures may include, but are not limited to, the following:
Project implementation agencies shall carry out the maintenance, repair, stabilization, rehabilitation, restoration, preservation, conservation or reconstruction of any impacted historic resource, in a manner consistent with the Secretary of the Interior's Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings (1995), Weeks and Grimmer.

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MM 3.8-1d: The project implementation agencies shall secure a qualified environmental agency and/or architectural historian, or other such qualified person, as deemed necessary, to document any significant historical resource(s), by way of historic narrative, photographs, or architectural drawings.identifies

MM 3.8-2a: As part of the appropriate environmental review of individual projects, project implementation agencies shall consult with the Native American Heritage

Commission to determine whether known sacred sites are in the project area, and identify the Native American(s) to contact to obtain information about the project site.

MM 3.8-2b: Prior to construction activities, the project implementation agencies shall obtain a qualified archaeologist to conduct a record search at the appropriate Information Center of the California Archaeological Inventory to determine whether the project area has been previously surveyed and whether resources were identified.

MM 3.8-2c: As necessary prior to construction activities, project implementation agencies shall obtain a qualified archaeologist or architectural historian (depending on applicability) to conduct archaeological and/or historic architectural surveys as recommended by the Information Center. In the event the records indicate that no previous survey has been conducted, the Information Center will make a recommendation on whether a survey is warranted based on the sensitivity of the project area for cultural resources.

MM 3.8-2d: If the record search indicates that the project is located in an area rich with cultural materials, the project proponent shall retain a qualified archaeologist to monitor any subsurface operations, including but not limited to grading, excavation, trenching, or removal of existing features of the subject property.

MM 3.8-2e: Construction activities and excavation should be conducted to avoid cultural resources (if found). If avoidance is not feasible, further work may need to be done to determine the importance of a resource. The project implementation agencies shall obtain a qualified archaeologist familiar with the local archaeology, and/or an architectural historian should make recommendations regarding the work necessary to determine importance. If the cultural resource is determined to be important under state or federal guidelines, impacts on the cultural resource will need to be mitigated.

SCAG shall encourage project implementing agencies to avoid development of geologic formations of moderate to high sensitivity for paleontological resources.

MM 3.8-3a: As part of the appropriate environmental review of individual projects, the project implementation agencies shall obtain a qualified paleontologist to identify and evaluate paleontological resources where potential impacts are considered high; the paleontologist shall also conduct a field survey in these areas.

MM 3.8-3b: Construction activities shall avoid known paleontological resources, if feasible, especially if the resources in a particular lithic unit formation have been determined through detailed investigation to be unique. If avoidance is not feasible, paleontological resources should be excavated by the qualified paleontologist and given to a local agency, or other applicable institution, where they could be displayed.

MM 3.8-4a: As part of the appropriate environmental review of individual projects, the project implementation agencies, in the event of discovery or recognition of any human remains, during construction or excavation activities associated with the project, in any location other than a dedicated cemetery, shall cease further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until the coroner of the county in which the remains are discovered has been informed and has determined that no investigation of the cause of death is required.

MM 3.8-4b: If the remains are of Native American origin,
□ The coroner will contact the Native American Heritage Commission in order to ascertain the descendants from the deceased individual. The coroner shall make a recommendation to the landowner or the person responsible for the excavation work, for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods. This may include obtaining a qualified archaeologist or team of archaeologists to properly excavate the human remains.
Or,
□ If the Native American Heritage Commission is unable to identify a descendent or the descendant failed to make a recommendation within 24 hours after being notified by the commission, in which case
□ The landowner or his authorized representative shall obtain a Native American monitor, and an archaeologist, if recommended by the Native American monitor, and rebury the Native American human remains and any associated grave goods, with appropriate dignity, on the property and in a location that is not subject to further subsurface disturbance where the following conditions occur:
- The NAHC is unable to identify a descendant;
- The descendant identified fails to make a recommendation; or
The landowner or his authorized representative rejects the recommendation of the descendant, and the mediation by the Native American Heritage Commission fails to provide measures acceptable to the landowner.
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MM 3.8-5a: Future impacts to cultural resources shall be minimized through cooperation, information sharing, and program development of SCAG's Regional Comprehensive Plan and Guide and through SCAG's Energy and Environment Committee. SCAG shall consult with the resource agencies, such as the Office of Historic Preservation, during this update process.

Geology, Soils and Seismicity
MM 3.9-1a: Implementing agencies shall ensure that projects be designed in accordance with county and city code requirements for seismic groundshaking. The design of projects shall consider seismicity of the site, soil response at the site, and dynamic characteristics of the structure, in compliance with the appropriate California Building Code standards for construction in or near fault zones.
MM 3.9-1b: Implementing agencies shall ensure that projects located within or across Alquist-Priolo Zones comply with design requirements provided in Special Publication 117 published by the California Geological Survey, as well as relevant local, regional, state, and federal design criteria for construction in seismic areas.

MM 3.9-1c: The project implementing agencies shall ensure that geotechnical analysis be conducted within construction areas to ascertain soil types and local faulting prior to preparation of project designs.

MM 3.9-2a: The project implementing agencies shall ensure that project designs provide adequate slope drainage and appropriate landscaping to minimize the occurrence of slope instability and erosion. Design features shall include measures to reduce erosion from stormwater. Road cuts shall be designed to maximize the potential for revegetation.

MM 3.9-2b: Implementing agencies shall ensure that projects avoid landslide areas and potentially unstable slopes wherever feasible.

MM 3.9-2c: Where practicable, routes and project designs that would permanently alter unique geologic features shall be avoided.

MM 3.9-3a: Implementing agencies shall ensure that geotechnical investigations are conducted by a qualified geologist to identify the potential for subsidence and expansive soils. Recommended corrective measures, such as structural reinforcement and replacing soil with engineered fill, shall be implemented in project designs.

MM 3.9-3b: Implementing agencies shall ensure that, prior to preparing project designs, new and abandoned wells are identified within construction areas to ensure the stability of nearby soils.

Hazardous Materials

MM 3.10-1a: SCAG shall encourage the U.S. Department of Transportation, the Office of Emergency Services, and the California Department of Transportation to continue to conduct driver safety training programs and encourage the private sector to continue conducting driver safety training.

MM 3.10-1b: SCAG shall encourage the U.S. Department of Transportation and the California Highway Patrol to continue to enforce speed limits and existing regulations governing goods movement and hazardous materials transportation.

MM 3.10-1c: SCAG shall encourage federal, state, and local efforts to educate businesses on the use of less dangerous alternatives to hazardous materials.

MM 3.10-3a: SCAG shall encourage the U.S. Department of Transportation, the Office of Emergency Services, and the California Department of Transportation to continue to conduct driver safety training programs and encourage the private sector to continue conducting driver safety training.

MM 3.10-3b: SCAG shall encourage the U.S. Department of Transportation and the California Highway Patrol to continue to enforce speed limits and existing regulations governing goods movement and hazardous materials transportation.

MM 3.10-3c: Prior to approval of any RTP project, the Lead Agency for each individual project shall consider existing and known planned school locations when determining the alignment of new transportation projects and modifications to existing transportation facilities.

MM 3.10-3d: SCAG shall encourage federal, state, and local efforts to educate businesses on the use of less dangerous alternatives to hazardous materials.

MM 3.10-4a: Prior to approval of any RTP project, the project implementing agency shall consult all known databases of contaminated sites in the process of planning, environmental clearance, and construction for projects included in the 2004 RTP. Where contaminated sites are identified, the project implementation agency shall develop appropriate mitigation measures to assure that worker and public exposure is minimized to an acceptable level and to prevent any further environmental contamination as a result of construction.

MM 3.10-6a: As with new or expanded transportation projects, planners and private developers can and should check published lists of contaminated properties, which are continually updated, to identify cases where new development would involve the disturbance of contaminated properties.previous

Energy

MM 3.11-2a: Project implementation agencies shall review energy impacts as part of project-specific environmental review as required by CEQA. For any identified impacts, appropriate mitigation measures should be identified. The project implementation agency or local jurisdiction shall be responsible for ensuring adherence to the mitigation measures.

MM 3.11-2b: For any project anticipated to require substantial electrical usage, the project implementing agency shall submit projected electricity and natural gas demand can becalculations to the local electricity or natural gas provider, respectively, for its analysis. Any infrastructure improvements necessary for project construction shall or should be completed according to the specifications of the energy provider.

MM 3.11-2c: Transit providers shall, as feasible, assure that designers of new transit stations incorporate solar panels in roofing and tap other renewable energy sources to offset new demand on conventional power sources.

MM 3.11-2d: SCAG shall encourage state and federal lawmakers and regulatory agencies to pursue the design of programs to either require or incentivize the expanded availability and use of alternative-fuel vehicles to reduce the impact of shifts in petroleum fuel supply and price.

MM 3.11-3a: SCAG shall continue to work with local jurisdictions and energy providers, through its Energy and Environment Committee and other means, to encourage regional-scale planning for improved energy management. Future impacts to energy shall be

minimized through cooperative planning and information sharing within the SCAG region. This cooperative planning shall occur during the update of the Energy chapter of SCAG's Regional Comprehensive Plan and Guide.

Water Resources

MM 3.12-1a: Transportation improvements shall comply with federal, state, and local regulations regarding storm water management. State-owned highways and other transportation facilities are subject to compliance with a statewide stormwater permit issued to Caltrans.

MM 3.12-1b: Project implementation agencies shall ensure that new facilities include water quality control features such as drainage channels, detention basins, and vegetated buffers to prevent pollution of adjacent water resources by polluted runoff. Wherever feasible, detention basins shall be equipped with with oil and grease traps and other appropriate, effective, and well-maintained control measures.

MM 3.12-1c: Project implementation agencies shall ensure that operational best management practices for street cleaning, litter control, and catch basin cleaning are implemented to prevent water quality degradation.

MM 3.12-1d: Storm Water Pollution Prevention Plans shall be submitted to the State Water Resources Control Board when proposed transportation improvement projects require construction activities. In these activities Best Management Practices shall be followed to manage site erosion and spill control.

MM 3.12-1e: Projects requiring the discharge of dredged or fill materials into U.S. waters, including wetlands, shall comply with sections 404 and 401 of the Clean Water Act including the requirement to obtain a permit from the U.S. Army Corps of Engineers and the governing Regional Water Quality Control Board.

MM 3.12-1f: Long-term sediment control shall include an erosion control and revegetation program designed to allow reestablishment of native vegetation on slopes and undeveloped areas.

MM 3.12-1g: Drainage of roadway runoff should, wherever possible, be designed to run through vegetated median strips, contoured to provide adequate storage capacity and to provide overland flow, detention and infiltration before it reaches culverts. Detention basins and ponds, aside from controlling runoff rates, can also remove particulate pollutants through settling.

MM 3.12-2a: Project implementation agencies shall avoid designs that require continual dewatering where feasible.

MM 3.12-2b: Project implementation agencies shall ensure that projects that do require continual dewatering facilities implement monitoring systems and long-term administrative procedures to ensure proper water management that prevents degrading of

surface water and minimizes adverse impacts on groundwater for the life of the project. Construction designs shall comply with appropriate building codes and standard practices including the Uniform Building Code.

MM 3.12-2c: Detention basins, infiltration strips, and other features to control surface runoff and facilitate groundwater recharge shall be incorporated into the design of new transportation projects.

MM 3.12-3a: Natural riparian conditions near projects shall be maintained, wherever feasible, to minimize the effects of stormwater flows at stream crossings.Suggest

MM 3.12-3b: Prior to construction, a drainage study shall be conducted for each new project. Drainage systems shall be designed to maximize the dissipation of storm flow velocities with the use of detention basins and vegetated areas, measures that will reduce storm flow risks to areas downstream of a project. Projects shall consider designs for the lateral transmission of storm water and other similar means to minimize the risks of upstream flooding.

MM 3.12-3c: All roadbeds for new highway and rail facilities should be elevated at least one foot above the 100-year base flood elevation. Since alluvial fan flooding is not often identified on FEMA flood maps, the risk of alluvial fan flooding shall be evaluated and projects shall be sited to avoid alluvial fan flooding where feasible.

MM 3.12-3d: Transportation improvements shall comply with local, state, and federal floodplain regulations. Projects requiring federal approval or funding shall comply with Executive Order 11988 on Floodplain Management, which requires avoidance of incompatible floodplain development, restoration and preservation of the natural and beneficial floodplain values, and maintenance of consistency with the standards and criteria of the National Flood Insurance Program.

MM 3.12-3e: Improvement projects on existing facilities shall include upgrades to stormwater drainage facilities to accommodate any increased runoff volumes. These upgrades may include the construction of detention basins or structures that will delay peak flows and reduce flow velocities. System designs shall be completed to eliminate increases in peak flow rates from current levels.

MM 3.12-4a: SCAG shall continue to work with local jurisdictions and water quality agencies, through its Water Policy Task Force and other means, to encourage regional-scale planning for improved water quality management and pollution prevention. Future impacts to water quality shall be avoided through cooperative planning, information sharing and comprehensive pollution control measure development within the SCAG region. This cooperative planning shall occur during the update of the Water Resources and Water Quality chapters of SCAG's Regional Comprehensive Plan and Guide and through SCAG's Water Policy Task Force. This task force offers an opportunity for local jurisdictions and water agencies to share information and strategies to plan for water quality in the region.

MM 3.12-5a: SCAG shall continue to work with local jurisdictions and water agencies, through its Water Policy Task Force and other means, including the update of the Water Quality and Water Resources chapters for SCAG's Regional Comprehensive Plan and Guide, to encourage regional-scale planning for improved stormwater management and groundwater recharge. Future adverse impacts shall be avoided through cooperative planning, information sharing, and comprehensive implementation efforts within the SCAG region. SCAG's Water Policy Task Force offers an opportunity for local jurisdictions and water agencies to share information and strategies for improving regional performance in these efforts.

MM 3.12-7a: Local jurisdictions should encourage new development and industry to locate in those service areas with existing wastewater infrastructure and treatment capacity.

MM 3.12-7b: Wastewater treatment agencies are encouraged to have expansion plans, approvals and financing in place once their facilities are operating at 80 percent of capacity. Through the update to the Water Quality and Water Resources chapters of SCAG's Regional Comprehensive Plan and Guide, SCAG shall provide opportunities for information sharing and program development.

MM 3.12-7c: Local jurisdictions should promote reduced wastewater system demand by:

- □ designing wastewater systems to minimize inflow and infiltration to the extent feasible,
- □ reducing overall source water generation by domestic and industrial users,
- □ deferring development approvals for industries that generate high volumes of wastewater until wastewater agencies have expanded capacity.

MM 3.12-8a: SCAG shall facilitate local water agencies' informing local jurisdictions of their continued efforts to evaluate future water demands and establish the necessary supply and infrastructure, as documented in their Urban Water Management Plans.

MM 3.12-8b: SCAG shall facilitate local water agencies' informing local jurisdictions of their continued efforts to develop supplies to meet projected demand in 2030.

MM 3.12-8c: SCAG shall facilitate information-sharing about the kind of regional coordination throughout California and the Colorado River Basin that develops and supports sustainable growth policies.

MM 3.12-8d: Future impacts to water supply shall be minimized through cooperation, information sharing, and program development during the update of the Water Resources chapter of SCAG's Regional Comprehensive Plan and Guide and through SCAG's Water Policy Task Force. This task force presents an opportunity for local jurisdictions and water agencies to share information and strategies (such as those listed above) about their on-going water supply planning efforts, including the following types of actions:

□ Minimize impacts to water supply by developing incentives, education and policies to further encourage water conservation and thereby reduce demand.
□ Involve the region's water supply agencies in planning efforts in order to make water resource information, such as water supply and water quality, location of recharge areas and groundwater, and other useful information available to local jurisdictions for use in their land use planning and decisions.
□ Provide, as appropriate, legislative support and advocacy of regional water conservation, supply and water quality projects.
□ Promote water-efficient land use development.
The Water Policy Task Force and the update to SCAG's Regional Comprehensive Plan and Guide present an opportunity for SCAG to partner with the region's water agencies in outreaching to local government on important water supply issues. SCAG provides a unique opportunity to increase two-way communication between land use and water planners. The goals of the Task Force would not be to duplicate existing efforts of the water agencies.

Public Services and Utilities
MM 3.13-1a: The project implementation agency shall ensure that prior to construction all necessary local and state road and railroad encroachment permits are obtained. The project implementation agency shall also comply with all applicable conditions of approval. As deemed necessary by the governing jurisdiction, the road encroachment permits may require the contractor to prepare a traffic control plan in accordance with professional engineering standards prior to construction. Traffic control plans should include the following requirements:
1. Identification of all roadway locations where special construction techniques (e.g., directional drilling or night construction) would be used to minimize impacts to traffic flow.
2. Development of circulation and detour plans to minimize impacts to local street circulation. This may include the use of signing and flagging to guide vehicles through and/or around the construction zone.
3. Scheduling of truck trips outside of peak morning and evening commute hours.
4. Limiting of lane closures during peak hours to the extent possible.
5. Usage of haul routes minimizing truck traffic on local roadways to the extent possible.
6. Inclusion of detours for bicycles and pedestrians in all areas potentially affected by project construction.
7. Installation of traffic control devices as specified in the California Department of Transportation Manual of Traffic Controls for Construction and Maintenance Work Zones.
8. Development and implementation of access plans for highly sensitive land uses such as police and fire stations, transit stations, hospitals, and schools. The access plans would be developed with the facility owner or administrator. To minimize disruption of emergency vehicle access, affected jurisdictions shall be asked to identify detours for emergency vehicles, which will then be posted by the contractor. Notify in advance the facility owner or operator of the timing, location, and duration of construction activities and the locations of detours and lane closures.
9. Storage of construction materials only in designated areas.

10. Coordination with local transit agencies for temporary relocation of routes or bus stops in work zones, as necessary.

MM 3.13-1b: The project implementation agency shall identify projects in the 2004 RTP that require police protection, fire service, and emergency medical service and shall coordinate with the local fire department and police department to ensure that the existing public services and utilities would be able to handle the increase in demand for their services. If the current levels of services at the project site are found to be inadequate, infrastructure improvements and/or personnel requirements for the appropriate public service shall be identified in each project's CEQA documentation.

MM 3.13-2a: Prior to construction, the implementing agency shall identify the locations of existing utility lines. The contractor shall avoid all known utility lines during construction.

MM 3.13-2b: The implementation agency shall work with the local jurisdiction(s) where the project is being built to ensure compliance with public utility codes and regulations.

MM 3.13-3a: Projects identified in the 2004 RTP that require solid waste collection will coordinate with the local public works department to ensure that the existing public services and utilities would be able to handle the increase. If the current infrastructure servicing the project site is found to be inadequate, infrastructure improvements for the appropriate public service or utility shall be identified in each project's CEQA documentation.

MM 3.13-3b: Each of the proposed projects identified in the 2004 RTP shall comply with applicable regulations related to solid waste disposal.

MM 3.13-3c: The construction contractor shall work with the respective County's Recycling Coordinator to ensure that source reduction techniques and recycling measures are incorporated into project construction.

MM 3.13-3d: The amount of solid waste generated during construction will be estimated prior to construction, and appropriate disposal sites will be identified and utilized.

MM 3.13-5a: SCAG shall encourage local jurisdictions to strengthen and fully enforce fire codes and regulations.

MM 3.13-5b: SCAG shall encourage the use of fire-resistant materials when constructing projects in areas with high fire threat.

MM 3.13-5c: SCAG shall encourage the use of fire-resistant vegetation and the elimination of brush and chaparral in the immediate vicinity of development in areas with high fire threat

MM 3.13-5d: SCAG shall help reduce fire threats in the region as part of the Growth Visioning process and as policies in the update of SCAG's Regional Comprehensive Plan and Guide.

MM 3.13-6a: Implementation agencies shall carefully evaluate the growth inducing potential of individual projects so that the full implications of the project are understood. Individual environmental documents shall quantify indirect impacts (growth that could be facilitated or induced) on public services and utilities to the extent feasible. Lead and responsible agencies then will make any necessary adjustments to the applicable General Plan. Any such identified adjustment shall be communicated to SCAG.

MM 3.13-7a: Project implementation agencies shall undertake project specific review of the public utilities and services as part of project specific environmental review. For any identified impacts, project implementation agencies shall ensure that the appropriate school district has the school capacity, or is planning for the capacity, that the project will generate. Appropriate mitigation measures, such as new school construction or expansion, shall be identified. The project implementation agencies or local jurisdiction shall be responsible for ensuring adherence to the mitigation measures. SCAG shall be provided with documentation of compliance with any necessary mitigation measures.

MM 3.13-8a: Prior to construction, the implementing agency shall identify the locations of existing utility lines. The contractor shall avoid all known utility lines during construction.

MM 3.13-8b: The implementation agency shall work with the local jurisdiction(s) where the project is being built to ensure compliance with public utility codes and regulations.

MM 3.13-9a: SCAG shall encourage the California Integrated Waste Management Board to continue to enforce solid waste diversion mandates that are enacted by the Legislature.

MM 3.13-9b: SCAG shall encourage local jurisdictions to continue to adopt programs to comply with state solid waste diversion rate mandates and, where possible, shall encourage further recycling to exceed these rates.

MM 3.13-9c: Future impacts related to management of solid waste shall be minimized through cooperation, information sharing, and program development during the update of the Integrated Solid Waste Management chapter of SCAG's Regional Comprehensive Plan and Guide and through SCAG's Energy and Environment Committee. SCAG shall consult with the California Integrated Waste Management Board during this process.

MEMO

DATE: September 12, 2006

TO: Open Space Working Group

FROM: Jill Egerman, Assistant Regional Planner, (213) 236-1919, egerman@scag.ca.gov

SUBJECT: Regional Comprehensive Plan Chapter Format and Structure

SUMMARY/BACKGROUND:

Staff has prepared a demonstration of the basic structure and format for Regional Comprehensive Plan (RCP) Chapters. The attached write-up both describes each of the elements of a plan chapter, and provides examples for Open Space and Habitat. It should be clearly noted, however, that the outcomes and strategies shown are not proposals for inclusion in the chapter, but merely demonstrations.

Attachment
Regional Comprehensive Plan (RCP) Open Space and Habitat Chapter: Basic Chapter Structure and Sample Outcomes/Strategies

Southern California Association of Governments
Regional Comprehensive Plan (RCP) Energy Chapter
Basic Chapter Structure
Sample Outcomes/Strategies

RCP Purpose and Approach

The Regional Comprehensive Plan (RCP) promotes policy objectives of the Regional Council, fulfills and implements the new organizational Strategic Plan, and serves to assist outside parties in implementing regional plans.

RCP Standard Chapter Sections -

Existing Conditions Section ("Problem Statement")

This section lays out the best available survey of information on the topic, emphasizing areas of particular interest consistent with performance outcomes.

Policies

The policy section compiles the full body of existing and new applicable regional policy in list form. This section is focused on the regional growth vision (2% Strategy) adopted in 2004.

Performance Outcomes

This section sets out a limited number (1-4) of specific quantified objectives. Consistent with "problem statement" emphasized in "Existing Conditions" section. The performance outcomes are the "centerpiece" of the chapter, and establish what the region is setting out to achieve.

Strategy and Actions

The Strategy and action section will describe specific activities intended to achieve the performance outcomes in the prior section. Shown below are generalized examples of strategies and actions. The actual plan chapter should make specific action recommendations for a variety of parties (e.g Federal governments, State, region, cities and counties).

Resources and Bibliography

This section will compile references and information resources.

NOTE – This write-up was prepared for the Open Space Working Group to demonstrate the intended structure of RCP Chapters. As such it presents 2 sample performance outcomes and associated actions and strategies. This ***should not*** be construed as a proposal to include these particular items in the plan. The RCP Purpose and Approach, and the example regional policy shown, however, do represent actions taken by the Regional Council, and will be included.

Examples for Open Space (see note)

Section	Example 1	Example 2
Existing Conditions (problem statement)	The region lacks sufficient community open space.	The region's natural habitat is threatened and segmented by development.
Policy	(The region will) develop strategies to encourage development of community open space.	(The region will) develop strategies to encourage habitat linkages.
Performance Outcome(s)	The region will increase acreage of active and passive recreation parks by 2020.	The region will increase viable habitat via linkages in each county by 2020.
Strategy and Actions	The region will establish land use patterns that increase frequency of park space. The region will establish infrastructure that supports access to park space. Governments will encourage maintenance of community open space. Governments will encourage creation and maintenance of community gardens.	The region will support the development of new technologies for modification of crossings. The region will support community awareness of importance and general locations of linkages. Governments will encourage maintenance of viable habitat linkages.

NOTE – This write-up was prepared for the Open Space Working Group to demonstrate the intended structure of RCP Chapters. As such it presents 2 sample performance outcomes and associated actions and strategies. This ***should not*** be construed as a proposal to include these particular items in the plan. The RCP Purpose and Approach, and the example regional policy shown, however, do represent actions taken by the Regional Council, and will be included.

MEMO

DATE: September 12, 2006

TO: Open Space Working Group

FROM: Jessica Kirchner, Associate Regional Planner, (213) 236-1983, kirchner@scag.ca.gov

SUBJECT: Draft Open Space Chapter Goals

SUMMARY:

During the prior fiscal year, staff engaged the RCP Task Force in discussion on potential performance outcomes for each chapter included in the RCP. Based on these discussions, a review of comparable plans, and available data, staff is now proposing initial performance outcomes along with the basic strategy intended to achieve those outcomes. Staff presented preliminary goals for the Open Space and Habitat chapter at the RCP Task Force meeting on September 11th. Due to the quantity of work that remains in order to develop the Open Space program, staff feels it would be inappropriate to present specific performance outcomes to either the Task Force or the Working Group at this time. Once the program has proceeded beyond the initial analysis, and a specific methodology has been identified, staff will return to the Task Force and the Working Group with quantified performance outcomes. As a result, this memo includes discussion of broad goals rather than specific performance outcomes.

ATTACHMENT:

Proposed goals

REGIONAL COMPREHENSIVE PLAN
Open Space and Habitat Chapter
September 2006

Goals and Strategies – Initial Proposal

Overview
The overall purpose of the Open Space and Habitat Chapter is to establish regional goals and an action plan – including measurable performance criteria for the protection of open space and habitat resources in Southern California. For purposes of this report "open space" is divided into three focus areas:

Natural open space - areas with regionally unique or threatened biological resources, large contiguous blocks of natural open space and areas that link large blocks of natural open space.

Community open space – recreation areas that function as regional facilities, open space that serves the daily needs or defines the character of local neighborhoods, and open space that connects or buffers land used in developed areas.

Agricultural lands – prime farmlands lands covered by the Williamson Act agricultural lands that function as buffers or linkages to natural open space and agricultural lands that are important components of community open space. Also all lands that currently have a General Plan Agricultural designation or have a designation that allows specific types of agricultural activities

SCAG will identify and designate lands within the SCAG region according to the following categories listed above. As part of the Land Use and Housing chapter additional lands will be designated as various types of "urban."

Goals[1]

1. **Goal:** Protection of natural open space areas identified as regionally important.
   Description: Inventory existing open space plans and programs to determine amount of natural open space under protection. Prioritize areas for protection.
   Potential Quantified Goal: acres preserved, percentage of priority areas preserved, reduction in rate of loss of natural open space
   Data considerations: will utilize a combination of SCAG data sets and data acquired by the consultant, requires identification of baseline, measures the rate at which open space loss occurs. Factors for the prioritization of natural open space include biological value (type and condition). Factors for prioritization of community open space include accessibility, regional importance, population served and uniqueness.

[1] SCAG, in partner with a consultant, is currently developing an Open Space Program. Although the team has completed a significant amount of work to date, a vast amount of analytical analysis remains. Due to the quantity of work that remains in program development, it would be inappropriate to include specific performance outcomes at this time. Once the program has proceeded beyond the initial analysis, and a specific methodology has been identified, staff will return to the task force with quantified performance outcomes. As a result, this memo includes discussion of goals rather than performance outcomes, by contrast to other RCP chapters.

2. **Goal:** Add community open space through infill/redevelopment.
   Description: Requires designation of "urban" parts of the region, cataloguing of infill areas and community open space
   Potential Quantified Goal: Increase in acres of community open space per 1,000 residents, increase in number of Compass partner cities using proposed design standards for infill/urban development
   Data Consideration: need to develop baseline for ratio, determine the types of community open space to include.

3. **Goal:** Urbanization
   Description: Requires designation of "urban" parts of the region
   Potential Quantified Goal: Reduction in rate of agricultural acres converted to non agricultural use or from one agricultural use to another.
   Data considerations: need to determine rate of agricultural conversion and percentage rate reduction.

Strategies

Activities/Plan provisions – The above-proposed goals will be achieved by the application a strategy involving the following actions. Through the development of the chapter, SCAG will establish the required levels of implementation action to achieve the specified goals.

Provide programmatic incentives for implementation, including finance

SCAG will identify resources to direct toward local agencies that choose to implement the provisions of this plan. Programmatic incentives include strengthened Intergovernmental Review (IGR), CEQA reform and/or General Plan consistency. Resources will include funds identified in the current state infrastructure bonds for regional planning incentives. In addition, SCAG will propose various new innovative finance mechanisms for this purpose such as benefit assessment districts, conservation tax credits, SAFETEA-LU (and other federal fund sources), Purchase-of-development rights, public private partnerships. Additional local funding mechanisms will be explored.

Building and design standards, including green building (also a land use strategy)

SCAG will develop a set of simple, broadly applicable standards for various types of urban development consistent with the 2% strategy. For example, regional centers identified in the 2% strategy should feature housing at a given range of density, floor area ratio, and orientation, etc. Further, SCAG will describe desired targets for green building.

Land use and urban design standards (for community/infill development)

SCAG will develop a set of simple, broadly applicable standards for various types of urban development consistent with the 2% strategy. These standards will focus on walkability, pedestrian friendliness, multi-modal systems and creation of community open space.

Implement 2% Strategy

SCAG will continue working with individual jurisdictions to collaborate on planning and development of key strategic growth areas identified in the 2% strategy.

Appendix I: SCAG Polices Pertaining to Open Space and Habitat

1	**Enhance Recreation and Tourism Opportunities**: Provide adequate land resources to meet the outdoor recreation needs of the present and future residents in the region and to promote tourism in the region. [1996 RCPG]
2	**Maintain Economic Productivity of Regional Lands**: Maintain adequate viable resource production lands, particularly lands devoted to commercial agriculture and mining operations. [1996 RCPG]
3	**Utilize Growth Forecasts In Natural Areas Planning**: The population, housing, and jobs forecasts, which are adopted by SCAG's Regional Council and that reflect local plans and policies, shall be used by SCAG in all phases of implementation and review. [1996 RCPG]
4	**Use Proactive Participatory Systems Approach for Natural Areas and Recreation Planning**: Future impacts to natural areas and recreation lands shall be avoided through cooperation, information sharing, and program development during the update of the Natural Areas and Conservation chapter of SCAG's Regional Comprehensive Plan and Guide and through SCAG's Energy and Environment Committee. [2004 RTP-EIR]
5	**Encourage Adaptive Reuse for Growth**: Encourage patterns of urban development and land use, which reduce costs on infrastructure construction and make better use of existing facilities. [1996 RCPG]
6	**Use Proactive Participatory Systems Approach for Ecological Conservation Planning**: Minimize future impacts to biological resources through cooperation, information sharing, and program development during the update of the Habitat and Natural Areas chapter of SCAG's Regional Comprehensive Plan, through SCAG's Energy and Environment Committee and in consultation with resource agencies. [2004 RTP-EIR]
7	**Encourage Planning for Environmentally Sensitive Lands**: Encourage planned development in locations least likely to cause environmental impact. [1996 RCPG]
8	**Use Proactive Participatory Systems Approach for Cultural Resource Planning**: Minimize future impacts to cultural resources through cooperation, information sharing, and program development of SCAG's Regional Comprehensive Plan and Guide, through SCAG's Energy and Environment Committee and in consultation with other resource agencies (such as the Office of Historic Preservation), during this update process. [2004 RTP-EIR]
9	**Preserve Forests and Designated Natural Areas**: National Forests shall remain permanently preserved and used as natural areas. SCAG shall support policies and actions that preserve natural areas areas identified in local, state, and federal plans. [1996 RCPG]
10	**Promote Low-impact Development Techniques**: Promote water-efficient land use development. [2004 RTP-EIR]
11	**Protect Ecologically Productive Lands**: Support the protection of vital resources such as wetlands, groundwater recharge areas, woodlands, production lands, and land containing unique and endangered plants and animals. [1996 RCPG]
12	**Promote Fire-wise Land Management**: Encourage the use of fire-resistant vegetation and the elimination of brush and chaparral in the immediate vicinity of development in areas with high fire threat. [2004 RTP-EIR]
13	**Preserve Cultural and Archeological Lands**: Encourage the implementation of measures aimed at the preservation and protection of recorded and unrecorded cultural resources and archaeological sites.[1996 RCPG]

14	**Promote Fire Management Planning**: Help reduce fire threats in the region as part of the Growth Visioning process and as policies in the update of SCAG's Regional Comprehensive Plan and Guide. [2004 RTP-EIR]
15	**Avoid Hazardous Lands**: Discourage development, or encourage the use of special design requirements, in areas with steep slopes, high fire, flood, and seismic hazards. [1996 RCPG]
16	**Coordinate Recreational Planning Within and Across Region**: Encourage member jurisdictions to work as partners to address regional outdoor recreation needs and to acquire the necessary funding for the implementation of their plans and programs. [2004 RTP-EIR]
17	**Support Sustainability Planning for Communities**: Support local jurisdictions and other service providers in their efforts to develop sustainable communities and provide, equally to all members of society, accessible and effective services such as: public education, housing, health care, social services, recreational facilities, law enforcement, and fire protection. [1996 RCPG]
18	**Encourage Conservation of Agricultural Lands**: Encourage implementation agencies to obtain assistance from the American Farmland Trust in developing and implementing farmland conservation measures. [2004 RTP-EIR]
19	**Improve Access to Natural Areas**: Increase the accessibility to natural areas lands for outdoor recreation. [1996 RCPG]
20	**Encourage Preservation of Agricultural Lands**: Encourage implementation agencies to avoid the premature conversion of farmlands by promoting infill development and the continuation of agricultural uses until urban development is imminent; if development of agricultural lands is necessary, growth should be directed to those lands on which the continued viability of agricultural production has been compromised by surrounding urban development or the loss of local markets. [2004 RTP-EIR]
21	**Enhance Sustainable Recreation Resource Management**: Promote self-sustaining regional recreation resources and facilities. [1996 RCPG]
22	**Encourage Protection of Agricultural Lands**: Encourage implementation agencies to establish transfer of development rights (TDR) programs to direct growth to less agriculturally valuable lands (while considering the potential effects at the sites receiving the transfer) and ensure the continued protection of the most agriculturally valuable land within each county through the purchase of the development rights for these lands. [2004 RTP-EIR]
23	**Maintain Buffer Zones**: Maintain natural areas for adequate protection of lives and properties against natural and man-made hazards. [1996 RCPG]
24	**Promote Multiple-Use Approach To Development**: Encourage that multiple use of spaces be allowed as feasible and practical, and encourage redevelopment activities to focus some investment on recreation uses so as to provide more opportunities for access to natural areas close to the urban core. [2004 RTP-EIR]
25	**Avoid Hazardous Areas**: Minimize potentially hazardous developments in hillsides, canyons, areas susceptible to flooding, earthquakes, wildfire and other known hazards, and areas with limited access for emergency equipment. [1996 RCPG]
26	**Support Cooperative Planning Across Levels of Organization (Systems Approach)**: Encourage member jurisdictions that have trails and trail segments determined to be regionally significant to work together to support regional trail networks. SCAG shall encourage joint use of utility, transportation and other rights-of-way, greenbelts, and biodiversity areas. [2004 RTP-EIR]
27	**Avoid Areas that Risk Health and Safety**: Minimize public expenditure for infrastructure and facilities to support urban type land uses in areas where public health and safety could not be guaranteed. [1996 RCPG]

28	**Support Livability and Integrate Natural and Human Uses of the Land**: Foster livability in all communities. [Growth Vision]
29	**Utilize Effective Ecosystem Management Planning**: Develop well-managed viable ecosystems or known habitats of rare, threatened and endangered species, including wetlands. [1996 RCPG]
30	**Preserve Environmentally Sensitive Areas**: Preserve rural, agricultural, recreational, and environmentally sensitive areas. [Growth Vision]
31	**Use An Ecosystem Approach To Regional Planning**: Encourage "watershed management" programs and strategies, recognizing the primary role of local governments in such efforts. [1996 RCPG]
32	**Protect Environmentally Sensitive Areas**: Protect sensitive environmental features such as steep slopes, wetlands, and stream corridors from development. [Growth Vision]
33	**Support Flow of Data and Information for Systems Approach to Planning**: Coordinate watershed management planning at the subregional level by (1) providing consistent regional data; (2) serving as a liaison between affected local, state, and federal watershed management agencies; and (3) ensuring that watershed planning is consistent with other planning objectives (e. g., transportation, air quality, water supply). [1996 RCPG]
34	**Support Sustainability Planning and Design**: Utilize "green" development techniques. [Growth Vision]
35	**Support Wetland Conservation**: Support regional efforts to identify and cooperatively plan for wetlands to facilitate both sustaining the amount and quality of wetlands in the region and expediting the process for obtaining wetlands permits. [1996 RCPG]
36	**Promote Smart Growth**: Promote infill development and redevelopment to revitalize existing communities. [Growth Vision]
37	**Encourage Integrative Planning**: Encourage mitigation measures that reduce noise in certain locations, measures aimed at preservation of biological and ecological resources, measures that would reduce exposure to seismic hazards, minimize earthquake damage, and to develop emergency response and recovery plans: [1996 RCPG]
38	**Ensure adequate access to Natural Areas**: [Growth Vision]